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MANURING RUBBER.

With the exception of the experiments begun at Peradeniya in the beginning of the year 1914 and which have consequently been running but a very short time as yet there are no records as far as we are aware of experiments in the field to determine the influence of the three principal manurial ingredients on the yield of dry rubber from Hevea.

The Department of Agriculture of the F. M. S. initiated some experiments in 1911 to test the value of different manures on the growth of young rubber trees as indicated by the increase in girth measurement. We have compiled the following table from the account published in the Agricultural Bulletin of the F. M. S. of November, 1913:—

TABLE I.

Plot.	No Manure.	Girth			Relative increase
		1911 in.	1912 in.	increase 2 years	control=100
6 & 13	Controls	2·53	9·46	6·93	100
	NITROGEN.				
2	Sulphate of Ammonia Lime	1·90	10·00	8·10	117
	PHOSPHORIC ACID.				
8	Double Superphosphate Lime	2·44	11·88	9·44	136

Plot.		Girth. 1911 in.	Girth. 1912 in.	increase 2 years.	Relative increase. control=100
	POTASH.				
7	Sulphate of Potash Lime	2·96	11·63	8·67	125
9	Lime	2·73	10·51	7·78	112

TABLE II.

	NITROGEN OMITTED.				
5	Double Superphosphate Sulphate of Potash Lime	2·01	10·94	8·93	129
	PHOSPHORIC ACID OMITTED.				
4	Sulphate of Ammonia Sulphate of Potash Lime	2·12	9·94	7·82	111
	POTASH OMITTED.				
1	Sulphate of Ammonia Double Superphosphate Lime	2·35	11·05	8·70	125
	LIME OMITTED.				
10 & 11		2·91	12	9·09	131

These two tables confirm one another in bringing out the influence of phosphoric acid. In table I, plot 8 manured with phosphoric acid (lime being added in each plot, the soil being very deficient in lime) gave an increase of girth measurement 36 per cent. in excess of that of the controls which had no manure at all, potash coming next with 25 per cent. excess and nitrogen last with 17. In table II, plot 4 with phosphoric acid omitted gave an increase of only 11 per cent. over that of the controls, against 25 per cent. with potash omitted and 29 per cent. with nitrogen omitted. The order in the second table was the same as that of the first, nitrogen being at the bottom in both cases.

It does not, of course, follow that the yield of dry rubber will correspond with the increase in girth and that those trees whose trunks have swelled the most will prove the best. Again, the experiments referred to above have been conducted only with saplings. We don't mean to say that a plantation in which the trees averaged, say, 60 inches in girth would not give more than one in which the average girth of the trees was 30 inches. It might be expected with reasonable certainty to give much more. But we have to await further data before concluding that with trees of the same generation and environment yield of latex is likely to be in proportion to size of girth when the difference in size is not great. In

some experiments that were carried out at Heneratgoda in 1913, published in Bulletin No. 4 of the Department of Agriculture, Ceylon, the largest tree under trial, the famous No. 2, with a girth of 117½ inches gave in 3½ months 45 lb. 3½ oz. of rubber, a quantity greatly in excess of any other; but it was not the largest tree in the plantation. The next best yielder which gave in the same period 24 lb. 2¼ oz. had a girth of only 65¾ inches and was nearly the smallest of those under experiment. The second largest—girth 115¾ inches—was 11th in order with 11 lb. 11½ oz.; the third largest gave only 8·5 lb. The mean girths and yields of the three plantations were as follows :—

	Mean girth : inches.	Average per tree Dry rubber 3½ months lb.	oz.
First plantation 15 trees.	85·88	11	15
Second ,, 10 ,,	76·27	7	14
Riverside ,, 13 ,,	71·57	12	0¾

from which it will be observed that the group of smallest trees gave the highest average yield.

The Peradeniya experiments referred to have not as yet been published, but the results for 1914 have been tabulated and we may be permitted a glance at them. The plot receiving an excess of phosphoric acid gave slightly better results than those receiving an excess of nitrogen and potash. The following table shows the comparison :—

	No. of trees.	Average yield per tree dry rubber, 1914. lb.	oz.
Plot 83, Excess of Nitrogen	42	2	6
,, 84, ,, ,, Phosphoric acid	34	2	7
,, 85, ,, ,, Potash	35	2	3

So far as they have gone the Peradeniya experiments tend to confirm the Malay experiments in the good influence exerted by phosphatic manures when applied to Hevea; but as already explained, a year is but a short time for such experiments. The results of one year's working must be distinguished from conclusions which can only be reached after many years when subsidiary influences have been eliminated.

R. N. L.

MR. ANDREW RUTHERFORD

GOVERNMENT ENTOMOLOGIST.

The Department of Agriculture, Ceylon, has suffered a serious loss by the death of MR. ANDREW RUTHERFORD which occurred at Kandy quite unexpectedly on February 3rd after a brief illness. His loss will be mourned, too, by a larger circle whose business or profession brought them in contact with him though on the social side he was less widely known; for so absorbed was he in his studies as to be left with little leisure to devote to the cultivation of life's diversions. Members of the Committee of Agricultural Experiments at whose meetings he was a regular attendant will connect his name chiefly with that elusive though destructive pest the Shot-hole Borer of Tea, and it is very largely due to MR. RUTHERFORD, who was the first to place the question in its proper perspective, that it is to be made the subject of special investigation to the ultimate benefit we hope of that great industry. MR. RUTHERFORD was appointed by the Secretary of State on MR. GREEN'S retirement and arrived in Ceylon on the 5th April, 1913. His career in Ceylon was a short one but it was long enough for him to have established a reputation for thoroughness, efficiency and hard work that won him the respect of all his colleagues. What he took in hand he carried through; but he was aware of what is known in his particular branch of science and also of what is not known, and never hesitated to declare it. MR. RUTHERFORD was a graduate of Edinburgh University and held the degrees of M.A. and B.Sc. He was professor of Biology at Cirencester College, going from there to the South Wales University College at Cardiff as Lecturer on Zoology and Botany. While at Cardiff he was offered one of the three CARNEGIE studentships for studying abroad which are bestowed each year upon young men of special outstanding merit. Accepting this he went first to Cornell University, U.S. America, and afterwards to the Illinois University. From there he visited Trinidad to attend an Agricultural Conference. Returning from the West Indies he went to Washington, the headquarters of the U.S. Department of Agriculture, and thence set out on a tour of field entomology in Florida. He was born on 24th March, 1878, and was thus 36 years old. This Journal loses in him a valued contributor, and we express our deep sympathy with his widow and her infant son.

MRS RUTHERFORD embarked for London by the "Worcestershire" which sailed on February 10th from Colombo.

MANURING TEA.

Supplementary to our article on manuring which appeared in last month's number we tabulate the published results of the 6 years' Tea Manure Experiments carried out on Pitakande Group. The drop in yields the third year—1901-2—is marked in each case.

TEA MANURE EXPERIMENTS ON PITAKANDE GROUP.

TEA SECURED PER ACRE.

Plot.		Feb. 1898 to Feb. 1899	Feb. 1899 to Jan 1900	Feb. 1900 to Jan. 1901	Feb. 1901 to Jan. 1902	Feb. 1902 to Jan. 1903	Feb. 1903 to Jan. 1904
		lb.	lb.	lb.	lb.	lb.	lb.
1	Control—No manure	707	784·264	850·625	377·67	500·85	356·582
2	400 lb: Blood meal						
	200 „ Basic Slag	889	931·709	1342·626	518·54	828·17	479·072
3	200 „ „ „						
	150 „ Sulp of Potash	855	894·007	1135·074	424·63	638·31	440·964
4	400 „ Blood meal						
	150 „ Sulp of Potash	955	960·068	1520·237	577·06	898·94	502·889
5	250 „ Basic Slag						
	400 „ Blood meal						
	150 „ Sulp of Potash	1055	1056·116	1461·714	583·18	861·51	547·121
6	200 „ Blood meal						
	250 „ Basic Slag						
	200 „ Sulp of Potash	1080	1064·499	1386 859	562·77	858·11	585·910
7	400 „ Castor Cake						
	400 „ Fish						
	100 „ Sulp of amnia						
	100 „ Nitr of Potash	1023	1064·222	1403·871	609·04	996·25	645·794
8	800 „ Castor Cake						
	200 „ Basic Slag	1091	1067·795	1394·344	592·03	951·34	579·785
9	800 „ Castor Cake						
	900 „ Bone meal	962	1005·631	1282·062	511·05	786·66	566·855
10	1120 „ Extra dissolved Guano	1206	1161·220	1581·482	664·16	717·93	513·097
	Average:	1012·8	1022·807	1389·807	560·273	837·468	540·165

We would also add that the application of Basic Slag and Potash in the Peradeniya experiments referred to in our last number occurred at each pruning and not annually as stated.

RUBBER.

THE EVALUATION OF CRUDE RUBBER.*

PHILIP SCHIDROWITZ.

"Evaluation" according to the view of the writer, means determination of quality or intrinsic worth. The term is, therefore, not synonymous with "valuation," which refers, or should refer, to market worth or price. In the past, many attempts have been made to determine the quality of crude rubber by chemical analysis; but it is now well recognised that a determination of the various constituents of crude rubber, such as sesin, ash, nitrogen etc., although useful and in many cases necessary, will not enable us to give a definite or final opinion of its quality.

The explanation of this fact is not far to seek, and it is that the physical or chemical nature of the rubber substance as such appears to vary appreciably in regard to its properties, and particularly with respect to its behaviour to the process of vulcanization. It may be, as PROFESSOR WYNDHAM DUNSTAN has suggested, that the time will come when a method of analysis, or some purely chemical operation, will be evolved, which will discriminate between different qualities of "pure" rubber. This indeed, would be a great step forward, yet still not a complete solution of the problem.

If we consider, in the first place, crude rubbers generally, the questions involved in the problem of evaluation are mainly the following:—

(1) What is the "washing loss"—i.e., how much commercial rubber will the material contain after water and mechanical impurities have been removed?

(2) What is the composition of the dry, cleaned material, i.e., roughly, how much non-rubber and how much rubber (resin, protein, etc.) does it contain?

(3) How does the clean material behave on vulcanization, and how does it compare, in this regard, with other rubbers?

Questions (2) and (3) might be recast in this form, so far as the problem concerns the manufacturer: "What will be the cost to him of this rubber in a given mixing, compared with the cost of other rubbers which he might use equally well for the same purpose? Also, will it behave normally or need special treatment?"

Dealing with wild rubbers, the determination of "washing loss" is essential. Chemical analysis also is useful in many instances for the purpose of ascertaining whether a rubber is, roughly, of the same type as other rubbers of the same commercial grade; as a method of identification and of rough grading; for the producer as a means of control. But, so far as actual commercial quality goes, if by this we mean intrinsic worth, or its immediate equivalent in pounds, shillings and pence to the manufacturer, chemical analysis, for the present at least, occupies a very secondary position compared with vulcanization tests.†

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† An exception must be made in regard to very resinous or low-grade gums. For goods of this class, analysis is not only desirable, but essential.

If chemical analysis can only play a relatively unimportant rôle in the evaluation of most wild rubbers, this is still more the case when we consider plantation rubbers, which, as a matter of fact, so far as the better grades are concerned, are nearly invariably of high chemical purity, and display, as regards absolute quantities of individual chemical "impurities," very little variation. It is possible, of course, that an apparently small variation of an individual "impurity," such as protein or insoluble matter, for instance, may have a considerable influence on quality, for all the available evidence points in the direction that the pure rubber hydrocarbon is a poor, "weak-kneed" substance so far as commercial quality goes. Before we know more, however, regarding the exact chemical composition of the various rubber "impurities" and of the effect of every constituent of impurities we classify as "resin," "protein," etc., on the process of vulcanization, and also on the behaviour of the goods in use and after storage, it is necessary, for purposes of practical evaluation, to rely mainly on vulcanization tests. Before dealing with these, it is desirable to refer to *viscosity* determinations on the crude substance. Broadly speaking, the experience of the author up to the time of writing is that good rubbers (i.e., those which yield superior vulcanized products) display a relatively high viscosity, whereas low viscosity figures indicate inferiority. Exceptions, or perhaps it were safer to say *apparent* exceptions, to this general rule, undoubtedly occur; but it seems quite likely that abnormal results may be due to defects in our methods of ascertaining viscosity. Some recent work by CASPARI on the composite nature of raw rubber (J. Soc. Chem. Ind., 1913-1914) appears to throw considerable light on this question, and it may well be that its thorough study will lead to the working out of a system of tests based on viscosity measurements which will be of the highest technical importance.

EVALUATION BY VULCANIZATION TESTS.

As, with certain insignificant exceptions, all rubber has to go through the process of vulcanization (either "hot" or "cold" cure) before it reaches the consumer, it is obvious that, for purposes of evaluation, the manufacturer must (or should) know (a) how the raw material behaves towards the curing process; (b) the general or, as the case may be, specific nature of the vulcanized product; (c) the probable effect of wear and age on the goods. It is conceivable that the time may come when the scientific study of the chemical and physical characteristics of the rubber substance proper, and of the "impurities" will have advanced so far that a chemical and physical examination of the *raw* product will afford all the data necessary for determining accurately its value from the point of view of the manufacturers' needs, as indicated above. Until then, however, it is clear that any practicable method of evaluation must be based on actual tests on the vulcanization of the raw material and the examination of the vulcanized product.

The *main object* in the evaluation of crude rubber is that of comparing various rubbers with one another in regard to their intrinsic merits and properties. At a first glance, this statement of the case may appear to be so obvious as not to be worth setting down in black and white; but as a matter of fact the problem has frequently been confused with questions of a different general, or of a more specific, character; for instance those connected with the behaviour of a particular rubber in a specific mixing, or the best method of employing a given type of rubber in various mixings, or what type of mixing is most suitable for a given purpose, and so on.

In other words, general evaluation methods should reveal comparable attributes or intrinsic worth. From the point of view of the relation of the producer to the consumer, it is desirable that a process of evaluation should be put in force which would, essentially, at once be a guarantee and a means of identification.

Secondly, we must make quite certain on applying vulcanization tests that the methods employed render an accurate comparison of quality possible. This applies (a) to the actual operations of mixing, vulcanizing, etc.; (b) to the methods of testing; (c) to the interpretation of the tests. There is a further consideration, namely, that the tests applied should afford, not only an accurate comparison, but a comparison which is relevant and of commercial value.

If we assume—and it is assuming a good deal—that the mechanical difficulties in regard to mixing * on a comparable basis have been overcome, the next step is that of carrying out the process of vulcanization in such a manner as to produce the *best cure attainable* in every case. Obviously, there can be no object in applying tests of strength, resiliency, durability, etc., to a product which is either over or under-cured in one case, correctly cured in the next case, and so on. It is the failure to recognise this fact in the past which has led to the publication of the results of many vulcanization tests of doubtful value, and incidentally, no doubt, to much trouble and financial loss in the factory.

It is obvious, then, that any rational scheme of evaluation by vulcanization must comprise a method whereby it is possible to determine accurately and readily what the best cure of any mixing, or rather of the test mixing, should be. Having got our "perfect cure," the next step is to apply appropriate tests in each case. In interpreting these tests we must not lose sight of the important inferences to be drawn from the behaviour of the rubber towards the vulcanization process, particularly as regards its *rate of cure*.

We will assume that we have determined on a comparable basis (1) how the rubber † cures, (2) how the cured rubber behaves; the next point is: how are we to correlate the results of our tests with general quality? This may be done by allotting for each attribute a certain number of marks, the total forming an "index figure" of quality. For each attribute a standard number of marks is allotted, the rubber receiving marks equal to, below, or above the standard, according to the results of tests. An, and at first sight reasonable, objection to this method is that the index figure of quality of any two rubbers might be the same and yet be arrived at by a different process; that is to say, whereas the marks given for specific attributes might vary, the total might in the two cases be the same. In practice the objection has little force. From the point of view of the producer it is desirable to know what is the value of a given rubber for general purposes. In view of the fact that the various attributes of a rubber are, more or less, interdependent, the index figure of quality should, if the marks are allotted on any reasonable basis, give a sufficiently close idea for commercial purposes of its value in this regard. So far as the consumer is concerned, the difficulty is

* And, in the case of wet or dirty rubber, of washing and drying.

† Assuming we start with a dry, clean, product.

met by informing him not only of the total number of marks, i.e., of the index figure of quality, but of the number which is given for each attribute. It is to be remembered that, for any given purpose, the consumer, in ninety-nine cases out of a hundred, looks, in buying, to obtain the best possible grade of rubber which will behave in a given mixing, or for a given purpose, in the same way as a previous lot of rubber which he has found satisfactory for this purpose. The manufacturer, therefore, in buying for a given purpose, will not seek to cover a wide range of type, and this is more particularly the case if we confine ourselves to plantation rubbers. If, for instance, a manufacturer has worked out a mixing with a batch of plantation smoked sheet which is satisfactory, he will, in buying again, be desirous of obtaining at a reasonable price another lot of smoked sheet which is equally suitable. If he fixes on a lot of smoked sheet which possesses not only the same index figure of quality but the same rate of cure, and approximately the same number of marks for each individual attribute, it is obvious that he will be buying a rubber which is substantially identical with the former lot of goods. The system of evaluation suggested offers, therefore, to the producer a fairly clear idea of general value, and to the consumer is a guarantee of, and guide to, specific quality.—RUBBER, COTTON, FIBRES, ETC., HANDBOOK.

THE PROPER METHOD OF PREPARING HEVEA RUBBER.*

V. CAYLA.

The periodical crisis to which the rubber market is subject makes it clear, without the necessity of further argument, that in the production of rubber the aim must always be to produce the quality which meets with the highest appreciation; since it is certain that, in such periods of crisis, almost without exception, the grade of rubber which will be most seriously affected is the one of inferior quality. It is difficult to predict the future of rubber as regards its extended uses; if for instance "hard" rubber will be relatively more used than the other kinds. But, according to the present condition of the demand in the manufacturing industry, there are a certain number of qualities which may be classed as amongst the first rank; and all these qualities are found in the highest degree and in the greatest number in the rubber known as "fine Para hard cure," grown in Brazil.

These properties of "fine Para" are of two kinds—1st, it has excellent durable qualities; 2nd, it unites in itself the highest degrees known up to the present of the mechanical and physical attributes required by the manufacturers. But this Brazilian variety has one defect—it has too much moisture, and contains too many impurities.

If, on the one hand, the Brazilian planter will have to continue his endeavours to put a cleaner and dryer product on the market, at the same time preserving its other high qualities, so must the planter of the East, without giving up the care which has made his "crepe" and "sheet" so pure an article, also use his endeavours to equal the mechanical and physical qualities of "hard cure;" a combination which up to the present has only been obtained very rarely, and to a certain extent by chance.

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The question is how to obtain a combination of the cleanliness, the necessary dryness, the suitability for keeping, and the highest physical and mechanical properties. That is what we will try to point out. It is understood that we only speak of raw rubber of a determinate chemical composition, i.e., one containing at most 2·5 per cent. of resin, such as is obtained from a sufficiently mature *Hevea brasiliensis.*

CLEANLINESS.

This is obtained by care in the preliminary stages, at the time of gathering the latex, by a straining of the same before coagulation, and by supervision of the workman during the process of coagulation, to see that there is no fraudulent admixture of foreign bodies during the operation, such as earth, stones, leaves, rubbish, etc. It cannot be doubted that such frauds are carried out by the Amazonian "seringueiros," who are paid by weight for the raw rubber. The introduction of raw rubber in the form of "feuilles" of from 0,005 to 0,008m, renders such a fraud practically impossible—for it is then easily detected. Neither are frauds of the kind possible when it is coagulated or worked up in the factory.

MOISTURE.

Two per cent. to four per cent. of moisture in commercial rubber seems to be the proportion preferred by the manufacturers. Desiccation is naturally obtained quickly and more easily for the commercial moulds from the less thick varieties, that is to say, from "crepe" and secondly from "sheet." The desiccation which is the most desirable is natural desiccation. But if spontaneous desiccation is easily applicable to Brazilian rubber, there is far more difficulty in the case of the plantations, where presses have to be employed to hasten the process. And this is, in our opinion, a defective method, for reasons which we will enumerate later on.

PRESERVATION.

It is necessary to have a rubber which, even in its raw state, before vulcanisation, will suffer as little change in its properties as possible. There are various causes for such alteration of quality. In consequence of the development of micro-organisms—such as fungi or bacteria—the rubber is irregularly spotted; without one's being able to say what injury has been caused, or even if there is any damage, the appearance of the rubber is altered and the rubber has depreciated. These micro-organisms do not develop themselves in rubber which is sufficiently dry, and one can prevent the appearance of spots by drying the "crepe" or the "sheet" sufficiently quickly. But the most serious, and also the most usual, change is the thickness, causing what is called "sticked rubber." Following the long discussions which have taken place with regard to the nature of this phenomenon, it appears certain that it is not a question of the action of a certain microbe, but of physical change in the molecular composition of the carburate of hydrogen ($C^{10}H^{16}$)which is the pure rubber, by the action of certain solar radiations in relation to the oxygen of the air. It is to be remarked that in the "fine Para hard cure" well prepared, these two changes in composition never take place.

Why? Because the Brazilian method *(defumacao)* of preparation of "fine Para" has incorporated in the mass of the rubber the various ingredients contained in the coagulating smoke, arising from the incomplete combustion of vegetable matters. Many of these substances are powerfu

antiseptics, which are unfavourable to the development of micro-organisms. And it is very probable that some of these ingredients "fix" the "rubber molecule," giving it a stability that the most active solar radiations, which might affect the rubber in any other case, cannot destroy.

PHYSICAL AND MECHANICAL QUALITIES.

The physical and mechanical qualities in rubber most highly appreciated by manufacturers are undoubtedly those found in "fine hard Para." What a number of reasons have been given for this superiority! Climate, the special type of the Amazon tree, the age of the trees worked, the method of coagulation, the quality of the smoke, etc., etc. Each of these factors has certainly its share of influence. But certain facts which have come to our knowledge lead us to believe that these are not all. In the study of the factors which determine the superior quality, one has first of all to consider the quality of the latex and of the substance which transforms the emulsion into a solid material, or rather a paste, that is to say, which throws out of gear the coagulation; but sufficient study has not been given to the phenomena which follow this stage. Now these have an undeniable importance. While on the plantations the freshly tapped rubber itself is pressed, in Brazil the "ball" or "borracha," is pressed alone. The close work which transforms the consistency of the coagulum also increases its cohesion and elasticity whilst diminishing its elasticity, and is a work of slow progression in the Amazon; in the East it is rough and rapid, thanks to the powerful presses. Now we feel sure that in order to obtain the highest physical and mechanical qualities the close work ought to be done slowly, spontaneously, and without mechanical action from outside. We know, in short, that if, in the Amazon, the smoked rubber is pressed, it loses its physical qualities.

This is not said in order to simplify the problem which the planters of the Middle East have to solve. Because if, in Brazil, thanks to the preservative properties which the method of "defumacao" gives to the rubber, it matters little if the desiccation is rapid, and if one is able, in order to hasten the process, to expose the balls or the sheets to the action of the sun without fear of stickiness developing, that is impossible on the plantations, where coagulation has been effected by means of acetic acid. Acetic acid is not, properly speaking, antiseptic; when the coagulum is fresh the micro-organisms develop freely; besides which, the "rubber molecule" is very sensitive to the direct action of the sun, and the action of drying has, therefore, to take place in the shade, which retards the operation and necessitates the construction and maintenance of dryers (barns or rooms) specially fitted up. It is this difficulty which has led to the use of presses which in a minimum of time eliminate a great part of the water and modify the consistency of the coagulum. For some time past, in order to still further shorten the period of desiccation, following the mechanical process, the "sheet" or "crepe" has been fumigated in special quarters, and the half dried and pressed rubber has been subjected to the action of smoke made by the burning of vegetable matter. In these smoked sheets or crepe, micro-organisms do not develop, nor is there any trace of stickiness. It is to be noted, however, that, contrary to that which takes place with the Amazonian "defumacao" method, the smoke does not penetrate into the mass of the rubber, which is solidified, and, therefore, the smoke can only act on the surface of the sheet or crepe.

In short, what procedure is one to adopt in order to obtain a very high quality rubber? First of all, only sufficiently matured trees must be tapped; the latex must be strained; the coagulation must be supervised so as to prevent all chance of fraud; in the coagulation care must be taken to give it good preservative qualities, and in this connection, amongst the known coagulants, vegetable smoke appears to be the most efficacious; and the fresh coagulum must not be pressed, but must be left to itself in the fresh air, to the action of rain and sun, so as to be transformed into a rubber sufficiently dry for commercial purposes.

Brazil is certainly the region where the methods employed most nearly approach the ideal conditions; it will be enough for them to abandon the form of "balls," from which recent results appear to have removed the importance, and to adopt the "sheet" system, which permits of improved and more rapid desiccation, greater cleanliness, and the elimination of fraud.

The Middle-East should endeavour to find a means of coagulation which permits of the advantages of spontaneous drying in the open air. Smoking would also seem to be indicated, but up to the present the smoking machines have not given satisfaction, and the method of "defumacao" or hand-smoking, which without doubt is the only one that gives excellent results, is extremely onerous when it is a question of large quantities of latex. In any case, pressing must be avoided, and if smoking almost immediately after coagulation permits of the abandonment of mechanical means, then its use must be made universal. Already "crepe" and "sheet" which has been smoked after having been pressed is enjoying deserved favour.

Let us observe, in conclusion, that all rubber that has been submitted to the action of smoke, during or after coagulation, is of a very dark colour; but, except in special and isolated cases, the dark colour, if it is uniform, is not a disadvantage to the rubber.—RUBBER, COTTON, FIBRES, ETC., HANDBOOK.

RUBBER AT THE LONDON EXHIBITION.

R. N. LYNE.

PLANTATION AND HARD CURE.

I gave a good deal of attention to the question of the relative merits of Plantation and hard fine Para, and in this connection what struck me more than anything else was the stolid indifference of manufacturers to academic arguments and tests conducted by those who were not themselves manufacturers. Indeed, the disregard of the average manufacturer extended further than this, and included his brother manufacturers who differed from him. Learned discussions might be proceeding in the conference room upstairs but he would sit serenely in his stand, surrounded by his goods, unaware indeed that they were taking place, and exhibiting no interest in them whatever. He made certain lines of goods, mostly of plantation rubber, the treatment of which for his particular purpose had cost him much trouble, time and money. With that experience behind him leading him to success, no one could be in a position to teach him his business; nor was he going to give away what had cost him so dear. That, briefly, was his attitude, of which we cannot complain. The lesson seems to be that it is

futile to try and prove the manufacturer wrong by laboratory tests, to quote statistics tending to show the superiority of Plantation over Hard Fine. I could get no manufacturer to admit that our product was equal to Hard Fine for goods that were required to stand the severest tests ; such, for example, as tyre valve tubing, large beer hose, rubber thread solutions, bottle rings, diving suits, railway buffers, better class tobacco pouches, golf balls.

I procured a large ball of Hard Fine from the Brazilian stand opposite ours and placed it on our stand for comparison with Plantation grades. It was one of a large pile of several tons. The great strength and nerve of this rubber was manifest; we had nothing to compare with it. It was almost impossible to rupture even the thinnest film. It is well known, of course, that the quality of a given parcel of rubber cannot be properly determined till it has been vulcanised, and nothing more is claimed in this case than the superiority of the Brazilian in the raw, making it easier to understand the statements of the manufacturer. This ball is now at Peradeniya.

One was naturally led on to inquire whether we shall ever be able to equal Hard Fine. Notwithstanding the fact that Plantation, as the manufacturers get to know more about it and how best to treat it, is gradually creeping up to hard Para in price, yet I believe the difference to be fundamental, and though the gap between the two will tend to get less, it will never close up.

In seeking to explain the difference we find the following circumstances :—

(1) Hevea in the East is growing in a new environment.
(2) The trees are younger than those of the forests of Brazil.
(3) The rubber is cured on a different principle.
(4) It is marketed in a much fresher condition ; that from the Amazon may be six or twelve months old before reaching the market.
(5) From the great lumps of Hard Fine air is excluded.

The influence of (2), whatever value it may have, will tend to decrease, and I was assured that the quality of Plantation, taking it all round, undoubtedly improved from year to year as the trees grew older.

We can never remedy (1) nor (3) completely, as it would, of course, never pay to adopt entirely the primitive hand-cure methods of the seringueiros.

Finally, there is the question of jât. It is now accepted that the seed Wickham procured came from the region of Hard Fine; only just within that region, yet undoubtedly within it. This region extends from the Madeira plateau westward for a thousand miles, and from Bolivia northward for a thousand miles. Judging from the variety of seed exhibited in the Brazilian stand, there must be many different jâts within that area. Indeed we know that rubber from the Madeira, for instance, differs from that from the Acre. Our seed is from the Madeira plateau, an altogether different region from Acre, near the borders of Bolivia, where some of the best rubber comes from. In the sketch map annexed* I have indicated the area approximately from which Hard Fine comes, and the locality from which MR. WICKHAM procured his seed. The line of enclosure was traced for me by one of the authorities at the Brazilian stand who had spent many years at Manaos in the rubber trade.

* Not reproduced.

THE POPULARITY OF PLANTATION.

This question of the relative merits of hard fine Para and Plantation is one about which I think we need not have any anxiety. It is like comparing Devon cattle with Highland, or Lincoln sheep with Merino; they are different products, and will never become identical. If Para enjoys a monopoly in some directions, Plantation enjoys it in others. Certain clean and clear classes of goods, like teats for babies' bottles, are only made from Plantation; as also articles, like a certain class of tobacco pouches, required to take a high colouring. Where they meet on common ground Plantation holds its own and more, though mainly because it is cheap. I went into one manufacturer's stand, hung about with a large number of exhibits, and asked him to point me out one made from hard Para exclusively. There were many made from Plantation only, some from Plantation and Para, but none of which he or any of his assistants could say was made from Para alone. A year or more ago tyre manufacturers were timid about acknowledging they used any Plantation, because even producers did not seem to be very fond of their product when it came to buying tyres for their own cars. Then one firm, endowed perhaps with clearer vision, boldly threw off the mask, and now all are calling the world to witness that their tyres are made almost entirely from plantation rubber, which has become not only popular, but fashionable.

SMOKE CURE.

By this I mean rubber cured by the application of hot smoke to the crude latex, of which samples cured by the Wickham, Colombo Commercial Company, Agar, and Reid-Till processes were exhibited on our stand. They attracted much attention, a group of people being continually round them inquiring into the principal points of the various systems. It was acknowledged that they gave the Ceylon stand a distinctive feature, illustrating as they did attempts to break new ground and advance. WICKHAM and AGAR machines were shown on separate stands in another part of the Exhibition. The specimens of smoke cure evidently met with approval; they possessed the qualities one usually associates with rubber—elasticity, springiness, closeness of texture, toughness. Uninitiated visitors had no difficulty in recognizing these specimens as rubber, though they often expressed astonishment when told crepe was rubber.

The advocates of smoke cure have been influenced chiefly by the fact that hard fine Para is cured in this way; but apart from this, when latex is smoked in bulk, they have a great deal of logic on their side. Of the two type grades in the market, opinion seems to be leaning towards smoked sheet as against crepe. Smoked sheet is first coagulated by acid, the sheets being subsequently put into a smoke chamber. It seems impossible under this system for the smoke to penetrate uniformly through the sheets. Admitting that smoke does at first permeate all parts of the coagulated sheet, it would seem probable that in the course of time, as the sheets set, less and less smoke would be able to find its way in, while more would be deposited without, a circumstance that would make for variability. On the other hand, if we can treat the latex in bulk before it is set we have a better opportunity of making sure that the smoke is thoroughly and uniformly mixed in.

The difficulty hitherto has been to contrive a machine that can deal with a large quantity of latex rapidly, simply, and cheaply. This would seem to be an engineer's rather than a chemist's task, and I have little doubt that before long we shall find it accomplished.

I found, however, a distinct opinion that, having established in the market two well-recognized grades of plantation rubber, namely, crepe and smoked sheet, to which the trade had got accustomed, some difficulty would be experienced in getting new types, such as block or cake, accepted on equal terms, even though they might be of equal or better quality and more uniform, a point upon which a manufacturer could only assure himself after long experience. The trade, having in the course of ten years or so got to understand, more or less, the two type grades, naturally do not exhibit enthusiasm over strange types which they cannot, perhaps, be sure of always getting, and with the treatment of which they are not familiar. As was said to me: "It has taken you years to establish your two grades; what do you want to change them for?" There is force in this argument, and I am of opinion that those now working along the lines of smoke cure should aim at turning out smoked sheet.—Report of the Ceylon Commissioner.

MATHEMATICS FOR AGRICULTURAL STUDENTS.

American students of Agriculture are taken through a very practical course of mathematics judging by a little volume that has reached us entitled "Mathematics for Agricultural Students" (McGraw-Hill Book Co., New York). Professor Wolff, the author explains that the book was designed as a text book for a working course in elementary mathematics given in the College of Agriculture of the University of Winconsin. It leads off with an excellent chapter on graphic representation, the visualizing of results by means of curves and diagrams, a method becoming every day more popular with authors in every branch of agricultural science.

There are chapters on the circle and triangle; the slide rule; pulleys, resultants and the inclined plane; the theory of probabilities, among others, and a useful appendix containing symbols, formulæ, and various tables.

WAR AND AGRICULTURE.

Mr. Tristram Eve, Secretary of the Farmers' Club, raised a very interesting discussion in that body on Monday by a paper on "War and Agriculture." Mr. Eve had some exceedingly sensible and encouraging things to say about our agricultural position; the fact is that agriculture has not suffered from the war, and the prospects of profit seem to be good. Mr. Eve has this advice to offer a farmer who as a citizen desires to help his country: "Keep your land clean; keep it drained; till and manure it really well, and sow what suits the farm and your style of farming. Give the sowing of wheat the turn of the scale." Mr. Eve has, it may be added, been recently appointed chairman of the committee appointed by the Government to deal with the question of farm produce for his Majesty's Forces.—English Paper.

COCONUTS.

COCONUT NOTES.

The Philippine Agriculturist, Vol. III., No. 2., contains some interesting references to the coconut.

One of the longer articles deals with the changes occurring in the ripening nut. In summarising these changes the author divides the development of the nut into three periods :—

During the first period there is an accumulation of invert sugar and amino acids in the milk or watery portion. The meat is still absent, the shell and husk are soft and watery, and the nut as a whole has its greatest diameter along the main axis.

During the second period of growth sucrose appears in the milk and the specific gravity of the latter is high. During all this time water is lost from the coconut, though its total weight continues to increase. The nut has meantime changed its shape, and begins to acquire its greatest diameter in a direction at right angles to the main axis.

During the closing period of ripening there is a sudden rise in the content of oil in the endosperm. The specific gravity of the milk falls at the same time owing to the transfer of nutrient materials or to respiration. In the meantime the shell has become impervious, and the drying out of the husk results in a loss in weight, which over-balances the gain in weight due to other changes.

Another communication deals with Lipase in the germinating nut Lipase is an enzyme which causes fats to become rancid, this result following upon the decomposition of the fats, through the agency of the enzyme, into glycerine and fatty acids. It is the latter that give the characteristic unpleasant odour associated with rancidity. Lipase is one of the factors in the deterioration of copra, but it is also believed to play an important and useful part in the germination of oily seeds.

As the result of investigations made at the Philippine College of Agriculture the following conclusions have been arrived at :—

(1) Lipase is present in the germinating coconut, both as an enzyme and as a zymogen which can be activated by dilute acids.

(2) It is found mainly in the outer part of the foot or haustorium ; smaller amounts occur in the water of the coconut and the inner surface of the endosperm.

(3) Potassium cyanide and sodium arsenite when used in a concentration of 0·4% stop the action of the enzyme.

(4) Thymol can be used in as high a concentration as 5% without any noticeable effect on the action of the enzyme.

(5) Boiling weakens but does not destroy the enzyme.

(6) Coconut lipase works best in the condition created by the addition of magnesium oxide ; that is, in a practically neutral medium.

(7) Attention is called to the use of magnesium oxide in the study of lipase, as constituting a valuable improvement over former methods of investigation.

What is known as the Macapuno coconut in the Philippines is locally called " Dikiri-pol," meaning " curd-coconut," because it contains in place of water (or, as it is erroneously called, milk) a jelly-like substance. The particular trees which yield these nuts do not have all their fruits of the same kind ; but as a rule bear some Macapuno nuts every year. These nuts do not germinate, but it is believed that other nuts from the same palm will produce trees of a similar character. The trees are generally found growing in groups in old coconut gardens, a fact which might indicate predisposing soil peculiarities. According to chemical analysis the same solid portion of the jelly-like mass is slightly richer in protein but much poorer in oil than the ordinary nut. The softer portion contains more protein and oil than does the coconut water. The Macapuno nut is manifestly a sport, but the influences that have produced the sport have yet to be discovered.

C. D.

COCONUTS IN THE DRY ZONE.

The ninth picking of 1914 was made on October 22nd. The number of nuts collected was 1,968 from 311 trees.

This gives a total of 13,316 nuts for the pickings of 1914 to date from an area of 23½ acres, composed of 17 acres of six year old and 6½ acres of seven year old trees (number of trees per acre 70).

In the ploughed and harrowed area (six year old trees), consisting of 1,224 trees, 283 trees gave 1,842 nuts, an average of 6·5 nuts per tree.

In the uncultivated area (seven year old trees), consisting of 449 trees, 28 trees gave 126 nuts, an average of 4·5 nuts per tree.

The tenth picking was made on December 11th. The number of nuts collected was 1,235 from 273 trees.

This gives a total of 14.551 nuts for the pickings of 1914 to date from the area stated above.

In the cultivated area, 255 trees gave 1,175 nuts, an average of 4·5 nuts per tree.

In the uncultivated area, 18 trees gave 60 nuts, an average of 3·25 nuts per tree.

No copra is being made at present owing to the rainy season. 36 cwt. 2 qrs. 5 lb. of copra was despatched to Colombo and sold on December 7th. This copra fetched prices as under :—

Copra No. 1: 34 cwt. 2qr. 5 lb. at Rs. 70 per candy.
Pieces 0 cwt. 3qr. 9 lb. at ,, 68 ,,

G. HARBORD,
Manager, E.S.

COCONUTS AT PERADENIYA.

A seven-year old palm in the young plantation is bearing a remarkable crop :—

Height to the cabbage	9½ feet.
Girth at 2 feet from ground	4 ,,
Number of unopened flower stalks ...	2
,, opened ,, ,, ...	5
,, bunches bearing nuts ...	13
Total number of nuts	179
,, ,, ,, on the largest bunch	33

D. S. CORLETT.

HARVESTING COCONUTS.

DEAR SIR,

With reference to the article on page 346 in the November number of the TROPICAL AGRICULTURIST (Advice to Coconut Planters), I should like to ask whether it is not a known fact that if nuts are allowed to ripen and fall, the subsequent yield of the tree is affected. As a matter of fact it is. I know of several instances, and to make doubly sure, I consulted not very long ago a good authority through the Agricultural Department who was also inclined to agree with me.

Among the Sinhalese there is a peculiar custom known as Gokbenduma in the Low-country and Tahanankéreema or Tahanchikereema among the Kandyans. This consists of the dedication of a tree to some deity as a kind of sacrifice with the object of restoring a sick person to health, the produce (frequently as oil to be burnt) being offered at a shrine. I have observed that the yield of such dedicated trees (which are allowed to drop their nuts) tends to decrease. Knowing the character of the Goiya, I had been under the impression that he generally offered his poorest tree, but in one particular case I took special note of, I was surprised to see the best tree chosen. I wonder if any one has made a proper test ; it would be interesting to know the facts.

Yours faithfully,

A. E. B.

[We have never heard this objection against allowing trees to shed their nuts on estates where the system is practised, as it is for example on some plantations in the Seychelles Group situated on islands secure from thieves. Cutting bunches before nuts are mature is a sort of pruning and may have the effect of forcing on other flowering stalks, thus increasing the number of immature nuts produced by the tree in a year. It would not, we think, increase the weight of copra produced, but on the contrary would tend to diminish it. We have always considered that, where circumstances permit of the custom, nuts should be allowed to fall and then be gathered, as a saving of labour is thereby effected. We should welcome the opinion of experienced coconut planters on the point.—ED. T. A.]

INSECTS INJURIOUS TO COCONUTS.

W. M. ADERS.

Rhinoceros bettle *(Oryctes monoceros and Oryctes boas):* These two species are still everywhere much in evidence, and are undoubtedly a most serious menace to the Coconut industry. A decree has been recently formulated to deal with this matter.

Oryctes monoceros is the commoner form, larvæ and pupæ abounding in decaying coconut trunks; *O.boas* more generally breeds in manure heaps.

The beetle is more injurious to young palms of 3 to 4 years old; if they survive this dangerous period the attack does not seem to cause such serious damage. Many young trees are killed outright, older trees are better able to withstand attack, but after repeated invasions become unproductive. As regards the length of the life-cycle no accurate records have been obtained; larvæ have been kept in captivity for over three months. Pupæ are not often found; the few obtained were discovered in old rotting trunks in association with larvæ.

But Rot is apparent in many plantations, and I am inclined to think is secondary to beetle attack. On opening a diseased crown a large quantity of evil-smelling liquid exuded, many *Muscidæ* being attracted to the spot and eagerly lapping up the exudate. The *Muscidæ* in question still await identification. These flies may be a factor in spreading the disease. Seedling nuts are sometimes attacked by termites, being completely ruined. The owner was advised to soak his nuts in Cooper's Dip before planting and better results were obtained. A peculiar blistering and wrinkling of nuts has been observed; all sizes are attacked, a resinous discharge exuding from the blisters. On several occasions around these cracks small weevils *(Calandra stigmaticollis, Gyll)* were found; in all probability adventitious.

Specimens and photographs were sent to Mr. Petch, Mycologist to the Ceylon Agricultural Department.

Nuts have been received in which the outer husks were smothered with a small scale *(Aspidiotus sp.)*. The leaves were not attacked.—Economic Zoology Report, 1913, Zanzibar Protectorate.

FENUGREEK.

The seeds of this plant (*Trigonella Fœnum-Græcum*) known in Sinhalese as "Uluhal" are commonly used in eastern cookery, and the following reference taken from the Monthly Bulletin of Agricultural Intelligence is of local interest :—

"Fenugreek seeds are exceptionally rich in nitrogen and phosphorus, the former in the form of albuminoids, the latter in the form of phythin, nucleo-albumin, and specially lecithin (1·5 to 1·7 %) which is present in greater quantity than in any other seed. The flour obtained from the decorticated seeds contains 5·81 % of nitrogen, corresponding to 36·3 % of albuminoid matter, 1·042 % of phosphoric acid, of which 0·135 % is in the form of lecithin, 0·758 % as phythin and 0·149 % as nucleo-albumin. These seeds are therefore of high nutritive value."

C. D.

CACAO.

FERMENTING CACAO.

PERADENIYA EXPERIMENT STATION.

No dried cacao has been sent for sale, owing to the low prices ruling in the market. Owing to the continuous rains the drying room had to be used, and during October proved inadequate to deal with the heavy crop.

The old method of adding the vinegar from one vat of fermenting cacao to the new vat for fermentation, has been tried again, in order to hasten and to obtain a more equal fermentation throughout. But in this case the vinegar was warmed to a temperature of 78% before being added to the cacao, in order not to check the fermentation, when once started. As one vat will not yield sufficient vinegar, the same amount of water is added and mixed with the vinegar. The cacao is not removed from the vats at all during this process but the vinegar and water well stirred in by being lightly trampled on. Thus an even temperature of 87% is maintained throughout the 64 hours of fermentation. The cacao receives two additions of vinegar and water at a ratio of about 3 gallons of mixed vinegar and water to about 700 lb. of wet cacao.

Samples of cacao treated in this manner and by the ordinary method of adding cold water have been submitted to MESSRS. KEELL AND WALDOCK.

The young cacao in the hill-side plot has been well mulched with Tephrosia candida and dadap, leaving the former uncut round each plant to form a wind screen and shade.

Four rounds of pickings have taken place, yielding a heavy crop. The second picking in November, owing to the continual wet weather yielded 25% of fungus pods.

The practice of continually picking off and burying the fungus pods, as generally carried out on estates, has not been followed. It seems the percentage of fungus on some estates has been very high, in spite of picking. Fungus pods are only gathered during the ordinary rounds of picking, once in three weeks, and buried with lime.

700 bamboo pots have been planted with selected Forastero seeds to fill up vacancies in all plots next year.

A visit was paid to Kondesalle Estate on November 11th, in company with MR. NEIL CAMPBELL to observe the methods of cultivation and manufacture employed there as compared with Peradeniya. The visit proved both interesting and instructive.

BROKERS' REPORT.

MESSRS. KEELL AND WALDOCK to whom samples of Cacao were sent report as follows :—

"Of the two samples of cacao you sent us for our report, in our opinion the sample cured by your usual method is decidedly the better both in break and in general appearance. In the sample cured by cacao vinegar the break is soft and dull in colour, and the dull appearance of the bean prevents it from passing as No. 1 quality."

D. S. CORLETT,

PADDY.

RESULTS OF LIGHT SEEDING OF PADDY.

The result of the last experiment on 3 acres which was initiated to test different rates of broadcast sowing a 4 month paddy, are as follows :—

Rate of sowing per acre		Yield per acre
1 bushel	...	$27\frac{3}{4}$ bushels
$\frac{3}{4}$,,	...	42 ,,
$\frac{1}{2}$,,	...	$54\frac{1}{2}$,,

The kind of paddy used was Suduvi, which gives a white rice. The bushel weight of this rice in normally dry condition was found to be 46 lb.

The quantity of paddy required for 1 bushel of rice was just two bushels.

No results could be obtained as regards the yield of straw per acre, as the setting in of the North-east Monsoon rains prevented the crop being harvested in the usual way.

Actually, the method of harvesting adopted was the cutting of the ears from the standing corn.

An experiment has now been started with the object of comparing the yield and feeding qualities of the imported paddies, yielding white rice and suitable for the consumption of estate coolies.

Three one-acre plots have been utilised and sown as under, during the last week of November.

Plot 1. Suduvi
,, 2. Molagu Samba
,, 3. Vadan Samba

Method of sowing :—$\frac{3}{4}$ bushels per acre broad-cast.

G. HARBORD.

APPLICATION OF MANURES AND PADDY

Dr. N. Kunjan Pillai, Director of Agriculture, Travancore State, has an interesting article on "Paddy Manures" in a recent number of the Indian Agricultural World. As a result of the experiments conducted by the Travancore Agricultural Department, under his supervision, he gives us two main conclusions which may as well be applied with great benefit in other places where the conditions of cultivation are not far different from those in Travancore.

(1) As far as the paddy crop is concerned, it is not only possible to replace cattle manure by mixture consisting of oil cakes, bone-meal and a nitrogenous fertilizer but even profitable to do so, for the application of these mixtures has, in all cases, resulted in larger yields and more profits than the application of cattle manure.

(2) Of the different nitrogenous fertilizers tried in combination with oil-cake and bone-meal, nitrolim (calcium cyanide) has produced the best results; and next to it, Am. sulphate, nitrate of lime and crude saltpetre, in order. The excellence of nitrolim is probably due to the presence of a large percentage of lime in its composition, which must naturally be beneficial to the wet lands in Travancore, which are generally deficient in lime and also probably to the existence of nitrogen in a form not readily soluble in water, so that the chances of loss after the application of the manure in the field are considerably reduced.

ARTIFICIAL MANURES.

Mr. Pillai says: "I have, no doubt, seen in scientific reports and other publications of some of the Agricultural Departments in India two statements which go against my conclusions. One is that the application of artificial manures to the paddy crop is not, as a rule, profitable, on account of their high cost. My experience in Travancore does not lend support to this statement. I find that nitrogenous fertilizers, when applied in comparatively small quantities in combination with oil-cakes and bone-meal, do produce beneficial results. The negative results obtained elsewhere may be due to the application of too large a quantity of such manures. In my experiments, the total cost of the manures has never exceeded Rs. 25 per acre, which is ordinarily the amount the ryots spend or ought to spend on manures for their paddy crops. The proportions of the constituents of my mixtures have been fixed, with due regard to the above point."

NITRATES.

"A second statement which is often seen in reports and which differs from my conclusions is that nitrogen in the form of nitrates is quite useless for the paddy crop, for the reason that such manures are readily soluble in water and are, therefore, likely to be completely washed away. There is, no doubt, a certain amount of truth in this statement, for we find, even from the experiments I have described above, that nitrates have not produced as good results as Am. sulphate and nitrolim. These experiments do not, however, show that nitrates are thoroughly useless. This beneficial result I attribute to the special precautions I have taken in the application of nitrates. In my experiments, I have applied them only as topdressing, and never along with other manures, during cultivation time; and the application itself has always been made as follows:—When the crop is 6 to 8 weeks old, the water standing in the field is completely drained, the nitrate mixed with ashes is spread in the field and water is let in again; and this water, as far as possible, is not allowed to run out of the field. By the adoption of such precautions in the application of nitrates and by limiting the quantity applied, so as not to swell the total cost of manures per acre much beyond the usual rates of expenditure incurred by the ryots, I have invariably obtained beneficial results."—The Wealth of India.

PADDY EXPERIMENTS.

The Madras Agricultural Students' Journal gives some details of a manuring trial at Vanyputtam. In an extent of 10·56 acres 21 Madras measures (25½ Ceylon measures) of Daincha (*Sesbania aculeata*) seed were sown on 1st May. After 3½ months, as soon as water was available for the

cultivation of paddy, the crop was ploughed in. The crop grew to a height of 8 feet and yielded about 55 cartloads of green leaf ordinarily worth about Rs. 10 per cart : whereas the expense of raising the green manure was under Rs. 50. It will thus be seen that while the expenditure on raising this crop was less than Rs. 5 per acre, the value of the green manure obtained was about Rs. 50.

The land into which the green manure was ploughed in was planted with single seedlings 12 in. to 18 in. apart, and gave a yield of 512 bushels of grain in spite of an attack of stem-borer. The ordinary yield of the field, without green manuring, would have been no higher than 31 bushels per acre against nearly 48 bushels obtained.

It was found that the seed rate of 2 Madras measures of Daincha per acre was too low, tending as it does to produce too much wood in the crop. A higher rate, say double the quantity, is to be recommended.

The best results are to be expected when the crop is ploughed in at flowering time. In the present case it was ploughed in too early. We are inclined to agree with the Editor of the Students' Journal that a spacing of 12 in. to 18 in. is too wide.

In another paddy trial one acre was planted with single seedlings 9 in. apart and gave a yield of 88 bushels, the ordinary yield of the field being 32 bushels.

C. D.

RICE CULTIVATION IN EGYPT.

The following note on rice cultivation in the Nile Delta (taken from the Agricultural Journal of Egypt) where such excellent yields are secured, will be read with interest. A feddan=1·038 acres, and a Kela=·45375 bushel.

The rice-growing area of the Egyptian delta is almost entirely confined to the northern portions of the provinces of Gharbia, Behera, Sharkia, and Dakahlia, and is further restricted to those parts where the summer water supply is good enough to allow of short rotation, and where, owing to injurious salts in the soil, rice is required as an ameliorating or reclamation crop. For land reclamation it may be necessary to grow rice for several years in succession, but when the land is improved, once in three years is sufficient. Rosetta is, and has been for centuries, the chief rice-growing centre. The area sown in rice in 1893 was 110,848 feddans. This steadily increased until 1904, when 211,308 feddans were sown, but this figure dropped again to 194,664 feddans in 1907. The steady increase in the area sown up to 1904 is probably largely due to the formation at this time of large land companies who undertook land reclamation on an extensive scale. The decline since that time may be due to several reasons, the principal ones probably being the financial crisis, the stopping of any fresh canalization of unreclaimed land, and the improvement of the land under reclamation, making the cultivation of other crops more profitable.

Several varieties of rice are grown, the best known being Yapani, Fion, Ein el Bint, Yamani, Fahl and Sabaeni.

Yapani is the most extensively grown. It is a white rice and a very heavy cropper, yielding up to 200 kelas per feddan. It is a comparatively small-grained rice, awnless, and short-strawed, and takes about 130 days to come to maturity. The percentage of husk in the paddy is about 20 per cent. by weight. There is a good demand for it in the market and it fetches a good price.

Fino is a very fine quality but takes very much longer to come to maturity, i.e., about 190 days. The grain is large and plump and awnless, and the straw is longer than that of Yapani. It does not give such a heavy yield but is said to be better for the land, probably merely on account of its taking longer to mature, and, consequently, affording a longer period for washing out injurious salts.

Ein el Bint is a bearded variety, is very hardy and often does well on land where the former two varieties do not succeed, and it can also stand a short supply of water better. The percentage of husk is 23. There are two subdivisions of this variety, one has a red-brown awn, the other an almost black awn. Ein el Bint means "girl's eye." In the first variety the eyelashes are said to be dyed with henna, and in the second darkened with kohl. The grain is very white and is an excellent eating rice. The straw is not so long or strong as that of Fino, but the crop matures much sooner, about 150-160 days after sowing. There is not a large market for it, and it is not extensively sown owing to its low yield (about 50 kelas per feddan on an average).

Yamani is an early maturing rice coming to harvest about 100 days after sowing. It is a white, bearded rice and yields rather more than Ein el Bint; the proportion of husk is also rather lower (22 per cent). It is useful for late sowing.

Fahl is a red-grained variety with white husk and awn; it takes the same time to mature as Ein el Bint and yields about the same. It has no special qualities to recommend it, and is, consequently, not extensively cultivated.

Sabaeni is sown as a flood rice, that is to say, it is sown in July before the Nile flood comes down. It gives a low yield per feddan, and the straw is short. The grain is large, flat and awned. The crop is ready for harvest about 90 days after sowing. The proportion of husk is about 23 per cent.

Rice generally, with the exception of Sabaeni, is sown in May and the earlier part of June.

It is essential that the land should be as level as possible before any further steps can be taken. Where there are any considerable differences in level in the field, it is perhaps more economical to divide it up into squares, varying, according to circumstances, from half a feddan to a few kerats, and then reduce each square to its own mean level. As this would increase the difficulties of irrigation, however, it is better, whenever possible, to reduce the whole area to approximately the same level. The divisions of the squares are made by means of small banks about 40 centimetres high. After these have been made and the work of levelling by "kassabias" finished, the land should be ploughed as deeply as possible. The next step is to flood the land and pass the "lowata" over it. This implement consists of an iron-shod beam about $3\frac{1}{2}$ metres long, with two iron rings about 75 centimetres from each end to which the yoke chains or ropes are attached, and a wooden handle about 1 metre long in the middle of, and set at right angles to, the beam.

This implement is drawn over the flooded land by a pair of cattle, and acts like a plane for paring off the higher parts and depositing them in the lower parts of the square. When the water is found to be lying evenly over the whole square the rice may be sown, at the rate of $2\frac{1}{2}$ to 4 kelas (23 to 27 kilos.) per feddan. In cases where the land is salty the water is run off, and fresh water let on before the seed is sown. Rice seed before sowing is put to soak for 3-8 days and is then taken out of the water, spread out and covered with green clover, rushes, etc., and left for 24-48 hours, by which time the radicle will have appeared. The water is changed at intervals of 2 days at first, but this of course must be regulated by the supply of water in the canals. After the first fortnight the water may be left on for eight days without harming the plant. The water standing on the land is usually 5-8 centimetres deep. If more than this, there is a tendency to uproot the young plants when there is a strong blowing. For the same reason it is preferable to run the water off in the latter part of the afternoon when the wind is usually strongest and when the sun is not so hot, and run on fresh water at dawn. When the rice is about a foot high, "dineba" (*Panicum crus galli*) and other weeds are pulled out. The "dineba" is generally fed off to cattle. Rice may also be transplanted at this time to fill in gaps where it has failed. In some places it is a common practice to buy rice plants in bundles for planting out in land which, for some reason, had not been prepared in time to sow in the ordinary way, but this transplanted rice does not give such a good return as that grown in the usual way. A few days before the rice is ready for harvesting the land is dried off and very often berseem is sown into the standing crop. Seven or eight men will cut a feddan in a day, using a small reaping hook, and the sheaves are carried to the threshing floor usually by women and girls. Threshing is done by means of the "norag" or native threshing machine, except on large estates where modern English threshers are used. Rice is hulled in small quantities by means of a stone mortar and wooden iron-shod pestle about 5 feet long, concave at the bottom. On a larger scale this work is done in various factories at Rosetta, Damietta, Alexandria and Zagazeg.

Very little is known at present of the insects that attack rice: the stalk borer does considerable damage, but no efficient way of dealing with this pest has been found. Clusters of pupæ are often found attached to the roots of the plants, but they do not seem to do much direct harm, unless, as it is thought, they act as floats, and so tend to uproot the young plant before it has taken a firm hold of the soil.

WET LAND PADDY.

In a recent publication issued by the Agricultural Research Institute of India dealing with the gases of swamp rice soils, the authors (Messrs. W. H. Harrison and Subramania Aiyer) showed that the gases formed in the soil appeared to have an important bearing on the æration of the roots of the paddy plant.

Further research by these same authors have resulted in a supplementary paper on the same subject. The conclusions arrived at, reproduced below, give some idea of the abstruse problems connected with the cultivation this, in many respects, peculiar plant.

1. The organized film in contact with the surface of Swamp Rice Soils utilizes the soil gases in such a manner as to bring about an increased oxygen output from the film leading to a correspondingly increased root æration.

2. The film contains bacteria which possess (1) the power to oxidize methane and hydrogen, and (2) to assimilate directly methane and carbon-dioxide. These changes either directly or indirectly result in the production of $C.O_2$, which is in turn assimilated by the green algæ with the evolution of oxygen.

3. The film may be looked upon as fulfilling the duty of an oxygen concentrator at a point which enables the maximum oxygen concentration to be produced in the water entering the soil.

4. The practice of green manuring by increasing the output of the soil gases brings about an increased activity on the part of the film, resulting in an increased oxygen production and root æration. An important indirect function, then, of green manuring is to bring about a greater root æration and so induce greater root development and cropping power.

5. The oxygen concentration of the water entering the soil appears to be one of the main factors which regulate the growth of the crop.

PRESERVING CUT FLOWERS.

Reports have been made in these pages of methods which claim to prolong the life of cut flowers. The methods consist in the addition of various salts to the water in which the stalks are placed. Comprehensive experiments carried out by PROFESSORS B. M. DUGGER and LEWIS KNUDSON at Cornell show, however, that little, if any, effect is produced by such additions of salts. The trials were made with Cosmos, Petunia, Aster, Verbena, Violet, Coreopsis, Dahlia, Tegetes erecta and T. patula, Geranium, Zinnia, Sweet Peas, and Pansies. Many different solutions were tried, including those of calcium nitrate, zinc sulphate, copper sulphate and common salt. Mixtures of salts were also employed. In no case was any striking result obtained, though not infrequently the treated flowers kept a day or so longer than those put into plain water. The fouling of water due to bacterial action, which takes place when certain cut flowers are kept in water, may be prevented by the addition of a trace of zinc sulphate or of copper sulphate. Boiling, burning, or mashing the cut ends of the stems—processes which are often recommended—proved useless, but the daily removal of the cut end—as is so commonly practised—was found to prolong the life of the flower.—GARDENERS' CHRONICLE.

FIBRES.

FLAX IN BRITISH EAST AFRICA.

For the last two years flax has been grown in many districts for the production of linseed only, the straw being burnt; but the reports on small samples of flax which were retted and scutched under very primitive conditions were so favourable as to justify the writer to ask for a short extension of leave to visit the flax producing districts in Ireland and Belgium and to enquire into the industry in these parts. The conclusions arrived at were that the conditions obtaining in the Protectorate were exceedingly favourable for the growing of this crop, and an expert (from Courtrai, Belgium) in the culture, retting and scutching of flax was appointed.

Since his arrival he has shown that lint of a very high quality can be produced, and has given practical demonstrations to many of our settlers who have visited Kabete Experimental Farm in the operations of retting and scutching.

A member (Mr. Wigglesworth) of one of the largest London firms of flax merchants, who recently visited the Protectorate, was present at one of the scutching demonstrations and valued the flax produced at £65 a ton which was at the time only £10 a ton below the best Belgium flax.

So favourably was he impressed, after a tour through the country, with the conditions obtaining for flax culture, that before leaving he made arrangements for the purchase of a farm, and has also joined in with a number of settlers for the establishment of a scutching factory at Lumbwa.

Over two-and-a-half tons per acre have been harvested at Kabete, on unmanured land, and when it is taken into consideration that two harvests can be obtained in the year (not necessarily on the same land), and, further, that all the operations, with the exception of scutching, can be performed by unskilled labour under white supervision, it is anticipated that the industry will rapidly develop into one of importance.—Annual Report of the Dept. of Agric., Br. E. Africa.

EFFECT OF THE WAR ON COTTON-GROWING IN THE EMPIRE.

J. ARTHUR HUTTON.

It is expected that the crop grown under the auspices of the Association (British Cotton Growing Association) during the past year will amount to about 100,000 bales, and it will be evident to everyone that if this crop could be reduced to 50,000 bales or increased to, say, 200,000 bales, it could only have a very slight effect on the value of the cotton crop of the whole world.

which, according to the Comtel Bureau Handbook, was estimated at close on 30,000,000 bales in 1913-14 as follows :—

	Bales.
The United States	14,610,000
India	5,987,000
Egypt	966,000
Brazil and other countries	7,740,000
Total ...	29,303,000

The main factor on which the price of cotton dep nds is undoubtedly the crop of the United States, and one of the principal reasons for the formation ot the British Cotton Growing Association and of other kindred bodies was to extend the cultivation of cotton throughout the world, so as to broaden the basis of supply and thus prevent those huge fluctuations in values which so seriously affect the welfare of the cotton manufacturing industry. In this connection we must not lose sight of the fact that during recent years the cost of production in America has increased very largely, and it therefore stands to reason that if prices fall to a very low level a considerable reductions in acreage is inevitable. It is difficult to say what is the actual cost of production, and it is quite possible that in some parts of the United States cotton can be produced at a cost of, say, 3*d*. per lb. On the other hand, in those districts where the conditions are less favourable cotton may cost 5*d*. per lb. or more to produce. I cannot emphasize too strongly the fact that the acreage planted depends almost entirely on those districts or on those plantations where the cost of production is highest. If cotton were to fall below, say, 4*d*, per lb., the farmer who can produce cotton at 3*d*. per lb. will still go on growing it, but on those farms where the cost is 4½*d*. or 5*d*., other more profitable crops will be substituted for cotton, with a consequent reduction in acreage.

I have gone through the statistics of the acreage in the United States for the last 20 years,. and I find that on almost every occasion, where there has been a considerable drop in prices, it was immediately followed by a reduction in acreage. For example, in 1894 the Liverpool price fell from a maximum of 4⅛*d*. to slightly below 3*d*,, and this was immediately followed in 1895 by a reduction in acreage from 23½ to 20 million acres. Again, in 1909, after a fall in price from 6·92*d*. to 4·80*d*., the acreage was reduced from 33,370,000 to 32,044,000 acres, and the reduction in acreage in 1912 from 36,681,000 to 34,766,000 acres was probably largely in consequence of the drop in price in 1911 from a maximum of 7·53*d*. to a minimum of 4·92*d*.

History has a habit of repeating itself, and I think it is evident from the above figures that we may anticipate a considerable reduction of acreage in 1915, and more especially so if low prices for cotton are coupled with high prices for wheat, corn, or other foodstuffs, which is more than probable. Nor should we forget that owing to increased cost of labour, etc., what used to be high prices twenty years ago would to-day give the farmer only a poor return, or, to put it into figures, any price below, say, 5*d*. a lb. will of necessity cause a reduction in acreage in those districts where the cost of production is over, say, 4¾*d*. per lb. The practical point is that, although cotton may occasionally fall below 4*d*. a lb., we must look on 4½*d*. to 5*d*. as a minimum average price over a period of years.

It is therefore evident that low prices either to-day or on future occasions are not of themselves sufficient reason for any relaxation of the efforts of the Association, for sooner or later they must cause a reduction in acreage with a corresponding rise in prices later on.

Taking everything into consideration, there seems to be no justification for pessimistic views as to the future of cotton growing in the British Empire. All we can hope is that the great efforts we and our allies are making may soon have a successful issue, and that in a short time we may see the end of what we all trust are only temporary difficulties and that the cotton trade may again enter upon another period of peace and prosperity.—Journal of the Textile Institute.

COTTON GROWING.

Mr. W. H. Scherffius, Chief of the Division of Tobacco and Cotton in the South African Department of Agriculture, in a recent address on the Cotton industry very pithily discussed the practical side of the subject. He observed that when we have the climatic conditions favourable, cotton can be grown on a variety of soils. Clay soils and rich alluviums tended to produce much foliage and little lint, especially when associated with moist conditions. In typical "black" soils splendid results are obtainable in good seasons but even with a scanty rainfall, once the plants are established, the crop will be very fair.

Speaking generally, he does not recommend irrigation for cotton, but if facilities exist for cheap irrigation he thinks it will pay. The soil should be kept moist but not wet.

In preparing the land, the soil should be broken deep and put into fine tilth before the seed is sown. The seed should then be sown in rows $3\frac{1}{2}$ to 4 feet apart, and when the plants are 4 to 6 inches high thin to one stalk about 18 to 24 inches apart in the row (this applies to annuals but not to perennials). The seed should be sown during the later part of October or 1st of November, when the first spring rains come. If sown by hand, 10 to 12 lb. per acre is sufficient ; if sown by machine, twice this amount will be necessary. The cotton plant requires constant cultivation, say, once every week or ten days. It is especially important to stir the surface soil after each rain as soon as it is dry enough to be in good working condition ; this prevents the excessive loss of moisture by capillary attraction. Continue to cultivate till the squares for the blooms begin to form ; cultivation should then cease. To produce a good yield of cotton it is necessary to have a good stand of plants in the field, and to have a good stand it is essential that only good seed with good vitality be sown. Poor quality seed may germinate and give trees, but they will be low in vitality and consequently give only weaklings, which are not capable of providing a good yield of cotton. One can greatly increase the yield of his cotton by going into the fields and selecting the trees which carry the greatest number of bolls ; and by sowing the seed from these trees the following year, and continuing this process for a few seasons, a highly prolific strain may be established.

Harvesting should begin when about a third of the bolls are open, and is usually done in three pickings, ten to twenty days apart. It is highly important that the cotton should be graded and the different qualities kept separate, otherwise the superior would be reduced to the grade of the inferior.

C. D.

SISAL HEMP IN BRITISH EAST AFRICA.

As a result of the experiments conducted with sisal plants in 1903-4-5-6 on the Government farms at Nairobi, Kibos and Merehini, and also in the Government House ground, Mombasa, it was proved that sisal could be satisfactorily grown on the coast belt, the Highlands and the Lake Districts, and that the plant readily adapts itself to varied climatic and soil conditions.

It is now estimated that there are some 7,000 acres laid out under the crop, and so satisfactory have been the returns from the plantations now being harvested that a large extension of the industry is likely to ensue; in fact large areas of virgin land are at present being broken up, and in one instance power machinery is being employed so as to bring a large block under cultivation at an early date.

A number of improvements have recently been effected in the decorticating machinery, and it is anticipated that the operations of brushing and drying the fibre will shortly be considered simplified, and so allow a large decrease in the number of hands employed, and therefore in the cost of labour.

On the coast the percentage of fibre is found to be higher than that in sisal grown in the Highlands, and further, that the fibre is finer and can be used for purposes for which Manilla hemp is at present utilised. In the Highlands, on the other hand, the yield of sisal per acre is considered to be greater, while the cost of labour is much less. The advantage, therefore, gained by growing the plant on the coast would appear to be counterbalanced by certain other advantages obtaining in the Highlands.

The following data collected at Punda Milia as a result of certain tests made by the writer last year will prove of interest to our sisal growers, viz. :—

(a) 912 leaves (middle cut) taken from two carts weighed 2,265 lb., or an average of 2·48 lb. per leaf. These leaves were decorticated, and the fibre dried and brushed fit for export. The yield of fibre was 52½ lb. (2·31 per cent.) or, roughly, 1 lb. of fibre from seventeen leaves.

(b) The spacing of the plants in the plantation from which the above leaves were cut was 8 feet by 8 feet, which gives 681 plants to the acre.

(c) From one plant about four years old, 198 leaves were cut which, if harvested under practical conditions, would all be fit for decortication, but as a basis of calculation an average of 160 leaves per plant has been taken. This is the average number cut from plants in German East Africa.

(d) Taking the above figures, viz., 2·48 lb. per leaf, 160 leaves (suitable for decortication) per plant, 681 plants to the acre, and 2·31 per cent. of fibre—the yield of fibre is just short of three tons to the acre, the actual weight being 6,240 lb.

The question how best to treat the land after the full crop has been harvested for further planting is one engaging the attention of the older planters. The removal of the green stumps or boles will entail some expenditure, and yet to leave them in the ground until they dry out sufficiently to be heaped and burnt will mean giving the weeds an opportunity of overrunning the land, and experience shows that land in this country which has been under cultivation and abandoned even for a short period becomes very foul.

The writer's experience in the destruction of the succulent prickly pear in the south with arsenite of soda would tend to the opinion that if the boles, immediately after the red leaves are cut, are injected with small quantities of this chemical the period of delay and drying up will be shortened and allow of their being burnt and the land ploughed again before weeds have become established to any great extent.

A series of experiments are now being conducted at Punda Milia with arsenite of soda.

SOME PRACTICAL QUESTIONS.

The following extract is from the report of Mr. Henry Powell, Chief of the Economic Plant Division :—

(a) Question : Capital required for planting one thousand acres ?
Answer : £3,000 (three thousand pounds).

(b) Question : Cost of machinery for the actual manufacture of the fibre ?

Answer : £4,500 (four thousand five hundred pounds).

(c) Question : Earliest time when a return may be expected ?
Answer : Four years.

(d) Question : What return may be expected per acre ?

Answer : One ton per acre for three years from date of first cutting.

(e) Question : The cost of production per acre ?

Answer : About £10 (ten pounds) per ton from the time the fibre leaves the plantation (including the cutting) to placing it on the London Market, allowing £1 (one pound) per ton for transport to the railway.

The following information regarding the Sisal Factory at Punda Milia is also put on record for possible future reference :—

(a) The power of working the factory is supplied by a suction gas engine, No. 3,120 of 75 h.p., and was obtained of "The Cundall Gas and Oil Engine Company," Keighley, England. If running for about ten hours the engine consumes about one-third of a ton of charcoal, which is made on the property from acacia and other trees.

(b) *Decorticating Machine.*—This is a "New Corona" by Krupp, and when fully working cleans about 100,000 leaves per hour, the output of fibre during a spell of eight hours being about two tons.

(c) *Washing.*—Immediately after decortication the fibre is washed in water contained in concrete tanks adjoining the factory, and is then hung out on wires in the open close by, where, on bright days, it quickly dries and is bleached as white as can be desired.

(d) *Beating or Cleaning Process.*—Various methods for freeing the dried fibre of pithy matter, dust, etc., have been tried at Punda Milia, but the best of all, and that now adopted, is a simple apparatus evolved, designed and fitted up by Mr. Rutherford, who, from the outset, has been associated with the Honourable Mr. T. R. Swift in establishing and developing the Sisal Estate under review. The apparatus referred to consists of two lengths of ordinary 3-inch piping, each firmly secured at either end to a central shaft which revolves at a rapid rate so that the fibre held in the hands of

men, properly protected by a wooden screen, is beaten so briskly by the pipes that practically all impurities are removed ; after one end of the fibre has been beaten it is reversed and the other end similarly treated.

(e) *Baling.*—After being weighed the thoroughly dry fibre is then placed in a "Patent Bijoli Press" by SHIRTLIFF BROS., Hampton Hill, Middlesex, England. The bales weigh 2 cwt. each, and are found a convenient weight and size for handling and the trade mark on the baling cloth is a zebra or Punda Milia, from which the native name of the plantation is derived.

About 1,000 acres are now established in sisal at Punda Milia, half of which area is mature for cutting, whilst a further considerable acreage will be planted with Agave Sisalana as fast as circumstances permit.

Tram lines have been laid down in the older section of the plantation for the purpose of transporting the sisal leaves to the factory, but owing to the delay in delivering the trolleys or waggons ordered from England the transport is at present mostly done by ox-carts.

During the past year or two the price of sisal hemp has fallen considerably, though from an original account sale showed me by the HONOURABLE MR. T. R. SWIFT I gathered that the fibre from Punda Milia was reported by the brokers to be in all essential respects of first-rate quality, and the price realised was a little more than £25 per ton. The further information was also given me that an order had been received at Punda Milia for the supply of 200 tons of sisal hemp during the next few months.—ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, BRITISH EAST AFRICA.

COTTON STAINERS.

W. M. ADERS.

Dysdercus fasciatus, F.—Cotton lint stainer. These stainers were prevalent during the bolling season, and caused much damage to the lint. All varieties of cotton were attacked, especially Caravonica. These insects were observed plunging their probosces into the young oily seeds, and staining the lint with their excrementa.

Eggs were found under small clods of soil; the plants had been screened for experimental purposes.

Food plants are as follows :—Cotton, Hibiscus esculentus, Eriodendron anfractuosum, Baobab Tree *(Adansonia digitata)*. Enormous numbers of adults and larvæ were found in the fruit of the latter tree. They are also fond of sucking the juices of mammalian carcases ; skins and skulls put out to dry were covered.

Dysdercus superstitiosus has also been taken from time to time on cotton.

CONTROL MEASURES.

Hand collecting was tried, the insects being swept into a small pail containing kerosene; this entailed a considerable amount of labour. Split Baobab fruits were placed between the rows, large numbers congregated on them ; these were tipped into a pail. This latter method worked well on our small experimental plot.—ECONOMIC ZOOLOGY REPORT, 1913, Zanzibar Protectorate.

TOBACCO.

TOBACCO PLANTING.

GOVERNMENT TRIAL GROUNDS, JAFFNA.

Although our first crop of tobacco has only recently been transplanted, some important points have been demonstrated which may be of interest to tobacco growers and readers of the Tropical Agriculturist.

PREPARATION AND SOWING OF NURSERIES.

It is the custom of Ceylon tobacco growers to sow the nurseries much too thick. Many sow the seed without mixing it with such filler as earth, ashes, meal or commercial fertilizer. This is absolutely necessary to secure a uniform distribution of seed. In this district the nurseries are then covered with bushy weed ; the object being to break the force of water when it is applied and to protect the germinating seeds from the rays of the sun. This method invites insects which use the covering for a hiding place while they feed on the tender plants. On account of the excessive quantity of seed-sown and the uneven distribution, the plants that escape the ravages of insects are usually in thick clusters or patches. This crowding not only retards the development of the seedlings but produces plants that are spindly in appearance, having but few roots and a low vitality. Such seedlings require much care when transplanted to prevent them from dying.

I would recommend that the nursery be located, preferably on virgin soil, as far as possible from thickets, fences and other places to which insects are attracted, and that the surrounding premises be kept free from weeds, bushes, etc. That an even distribution may result, the seed should be mixed with a filler to give bulk, and sown at the rate of a level tea-spoonful of seed to five square yards of nursery. A good method of protecting the germinating plants would be to erect a shade at least two or three feet above the nursery, that it may not be a hiding place for insects.

CARE AFTER TRANSPLANTING.

It is customary in the Island to shade the plants for a time after transplanting with weeds or leaves, and in this district the plants are watered three times daily. As they begin to grow the number of waterings is reduced. At the Tobacco Trial Grounds, the following method has been found satisfactory. The plants are not shaded and are only watered once every three or four days. The shade is not required because our seedlings are sturdy, and are properly transplanted by having the earth pressed firmly to the roots and leaving it more loose about the stem.

The watering is done as follows:—A hole is made by the side of the plant into which the water is poured (alternating to the opposite side of the plant at the next watering); as soon as the water has sunk into the ground, the hole is filled with loose earth. Thus a mulch is formed which conserves the moisture from speedy evaporation.

The tobacco growers who have visited our gardens readily see the advantage gained by these methods, as the great amount of unnecessary labour, however cheap, adds to the cost of production and subtracts from the profits of the crop.

B. F. SCHERFFIUS.

CULTIVATION OF TOBACCO.

NICHOLAS SACHOULIS.

PLANT BEDS.

Burn the site. Well-burned "beds" give the most satisfaction, as burning destroys the vegetable and insect life. Select for your seed-bed fresh land near the water where it is not shaded. Do not burn when the ground is wet. Close sides with brick or timber 6 to 8 in. high; allow the ashes to remain on the bed, spade up twice, and cross the depth of 9 to 12 in., so that the ashes are well mixed with the soil; rake until the ground is well pulverised.

Sow seed with ashes. Do not make beds too narrow—3 ft. by 30 in.; sow two tea-spoonfuls of seed to 100 square feet, and then take a board and press the surface so the seed is well covered with soil. After sowing, the beds should be covered with grass laid flat on the ground. Water the beds at once, using 15 gallons of water to every 100 square feet. When the plants begin to grow, water them twice a week, removing the coverings, and after rain take the grass off altogether. Cover the beds with open calico to make them insect proof. When the plants have four to six leaves, do not water them too much—only use just enough to keep them healthy. Thin out the plants and pull up any weeds, but these latter are not likely to be troublesome on "burnt" beds.

SELECTION OF SOIL.

For the production of bright pipe tobacco or Turkish Cigarette-leaf, the soil must contain a large percentage of sand. The sandy bank areas of the Inglewood district includes some excellent soils for Turkish, and, when the rainfall is sufficient, for cigar and Virginia types as well. Many of the granite soils will grow good Turkish. Among our best soils for all types are the reddish sandy loams created by the blending of granitic and gold belt soils; these often have both the texture and the fertility. Volcanic, heavy black, or red soils grow a leaf too coarse and heavy for market requirements, and soils containing "Brack" or alkali should always be avoided.

All tobacco soils should have good natural drainage, and it is of particular moment to note whether granitic soils are underlaid with an impervious subsoil. New land or those freshly broken up from grass produce the brightest-coloured leaf, but their use is conditional on their being worked up to a perfect tilth before planting time.

PREPARING LAND.

The preparation of the land should not be left until the planting season, but should be done as early as possible. Two ploughings, cross-furrowing, and two harrowings will be sufficient. Work the fields up to garden

tilth and keep them so by harrowing soon after every rain. Cultivation is one of the secrets of success in tobacco culture as well as any other crop culture, and it is just as important before planting as afterwards.

Tobacco plants that have been raised under cover should now be planted out as early as possible this month.

TRANSPLANTING.

Use strong, healthy plants only. Water bed before drawing plants; do not draw much ahead of planting requirements. Do not mix varieties. Give each variety the correct distance. Set the plants firmly; do not leave them dangling in a hole. Do not plant in a depression where soil can be washed over them. Define rows with a home-made marker.

For heavy pipe-tobacco, the plants should be set in straight rows 3½ feet apart; for cigar-leaf, the rows should be 3½ feet by 20 inches apart in the row; for cigarette-leaf, 3 feet by 15 inches.

The plants should be about 6 inches high when they are ready for transplanting and should be removed very carefully, and should not be allowed to get broken or dirty. Hollow out the place they are to be set in with a dibble—a pointed piece of wood. See that the hole is made large enough to allow the fibres of the roots to go straight down, and not allowed to double up or get twisted. Do not splash the water on the plants, but pour it in a hole beside them. Transplanting must be done at 4 o'clock in the afternoon after rain or in cloudy weather. Next morning the plants should be carefully covered over with light grass, to protect them from the heat of the sun till they have started growing. If dry weather prevails, each plant should be liberally supplied with water. Do not remove the grass when watering. Healthy plants take root in a week's time. After rain remove the grass altogether.

Better to plant out 300 to 500 a day, and look well after them, than 5,000 and leave them alone. Covering the plants in the field is the best means of ensuring success for the tobacco-grower. Replace misses as soon as convenient, and thus secure an even stand.

INSECTS.

Flocks of turkey, ducks, and fowls will hold these in check. Poison is the best thing. For grasshoppers and beetles, spray field and border with Paris green or arsenate of lead, 1 lb. making up to 50 gallons of spray.

CULTIVATION OF THE CROP.

When the plants have taken root, keep the soil thoroughly stirred by means of hand and horse-propelled implements. Do not permit earth to cake around the plants. Weeds are a breeding-place for fungoid diseases and insects. Good leaf depends upon rapid and constant growth. The growth is in a large measure dependent upon the degree of cultivation. With a hoe lighten the ground and remove all the weeds from the plants, giving them a chance to start with their growth.

When the plants are 8 to 10 inches high, if it is possible, after rain the horse hoe should be run between the rows. Nothing can be better than this tool; it is an ideal implement for hoeing between the rows, earthing up tobacco plants, and keeping the field clean for growing crops.

Topping, pruning, and suckering will be dealt with in a future article in the Journal.—Queensland Agricultural Journal.

FRUIT.

HINTS ON ORANGE CULTIVATION.

The Economic Botanist of the Central Province, India, has contributed some useful notes on the subject of orange cultivation to a recent number of the AGRICULTURAL AND CO-OPERATIVE GAZETTE (Nagpur).

He points out the importance of drainage in the cultivation of this crop which is particularly sensitive to standing water. If possible the land when being prepared for planting should be sloped off so as to allow of no low-lying places; otherwise surface drains must be depended on to carry off excess of moisture.

For oranges of the Nagpur type a spacing of 18 ft. × 18 ft. is recommended, which gives 134 trees to the acre. Holes for planting should not be less than 3 ft. cube.

As regards pruning we are told that orange trees cannot be pruned once they are big. It is the young plant that should be properly pruned, and if this is not done it will assume the form of a bush or shrub instead of a tree.

The ideal orange tree should have a clean stem rising 3 feet clear off the ground and a dome-shaped crown.

The cut ends of pruned branches should be dressed, and the following "ointment" is recommended, viz. Resin, 6 lb.; bees wax, 2 lb.; linseed 1 pint. These ingredients are heated together and stirred till properly mixed.

The advantages of growing properly pruned plants are that inter-cultivation is easy, the smaller number of branches in the crown have room for development, and better crops and better fruit are secured.

In irrigating or watering, do not run or pour water into a saucer-shaped depression round the main stem. The moisture should be distributed well round the tree so as to reach the feeding roots, and when the trees are old the water may be applied to furrows between the rows. The feeding roots should be encouraged as much as possible to spread and go in search of food.

A common trouble in orange cultivation is what is known as "die-back" where the ends of the branches wither and the drying gradually extends to the whole tree. The cause is said to be faulty cultivation and the cure good cultivation and manuring.

Neglect of proper pruning often brings on an attack by stem-borer whose ravages can be stopped by dropping kerosene into the burrows and killing the insect, afterwards covering over with the ointment referred to above.

C. D.

SOILS AND MANURES.

THE IMPORTANCE OF LIME IN THE SOIL.

Mr. Hall, in his presidential address of the British Association in Australia, in referring to the subject of soil exhaustion, indicated the chief factors which influence fertility as rainfall, the physical condition of the soil, and the presence of lime.

He attaches so much importance to the last as to place it first among these factors, inasmuch as upon the presence of carbonate of lime in the soils depends the production of available plant food as well as the natural regeneration of the soil.

This important agent being entirely under the control of the agriculturist, there should be no excuse for its absence from our cultivated areas. Our soils are generally deficient in lime, which however is easily obtainable.

C. D.

INSTRUCTIONS FOR TAKING AND COLLECTING OF SOIL SAMPLES.

A rough sketch of the field, paddock, or block of land from which the samples are to be taken should be prepared to accompany the samples. The spots where the samples are taken are marked on this plan, [not reproduced] and are numbered. This sketch plan should also indicate position of roads, creeks, gullies, ridges, general fall, and aspect of land, etc.

Should the soil in various parts of the block show a very marked difference, it will be necessary to divide the block into two or more parts. Should the different soil occur only in a small patch, this sample may be left out.

Not less than three samples should be taken in each section. A greater number is to be preferred, as a better average will be obtained. In order to obtain a fair average sample of the soil from a block of land, as nearly as possible equal quantities of soil are collected from various parts of the field.

At the places chosen for the taking of the samples the surface is slightly scraped with a sharp tool, to remove any surface vegetation which has not as yet become part of the soil.

Vertical holes from 10 to 18 inches square are dug in the ground to a depth of 3 feet. The holes are dug out like post-holes; an earth-auger facilitates the operation considerably, and the holes may be trimmed with the spade afterwards and cleaned out.

Careful note of the appearance of the freshly cut soil of an intermediate layer and of the subsoil should be taken. The depth of the real soil, which in most cases is easily distinguished, is also measured and noted for each hole. Note how deep the roots of the surface vegetation reach into the soil. If the soil changes gradually into the subsoil, as is the case in some places where the soil is of very great depth, this line of division can only be guessed approximately, and it is best to take the soil uniformly to a depth of 12 inches.

With a spade a slice of soil, from 3 to 4 inches thick, down to the beginning of the subsoil or to a depth of 12 inches, is now cut off and put on to a clean bag. The same is done with the subsoil, and the slice is taken from where the soil ends (or 12 inches) to the bottom of the hole, and this subsoil placed on another bag. Stones over the size of a pea may be picked out, the rough quantity of such stones estimated, and a few enclosed with the samples. Fine roots must not be taken out from the soil samples. The same operation is repeated at the other places chosen. Take careful note and give description of soils in each hole, as numbered and marked on plan. The samples of soil collected on the one bag are thoroughly mixed by breaking up any large clods, and about 10 lb. of the mixed soil are put into a clean canvas bag, which is securely tied up and labelled. The same is done with the samples of subsoil collected separately on the other bag.

All the samples collected are afterwards placed in a wooden box.

It is important to use clean bags and clean boxes, and also that the samples should not be left in the neighbourhood of stables or manure heaps.

A short description of the land must accompany the samples and the sketch plan. In the case of cultivated land, state how long the land has been under cultivation, what crops were chiefly grown, result of such crops, was any manure applied, when, and what sort, and in what quantities per acre. In the case of virgin soil, state if the land was heavily timbered or not, ringbarked, if scrub or forest land, what sort of timber was chiefly growing on the land. In all cases a description of the neighbouring land, outcropping rocks, etc., is of great value. Also state if the land is naturally or artificially drained or not; describe the land as regards its position to hills, roads, creeks, ridges, etc.

Only by adhering strictly to these instructions, and by giving minute details can benefit be derived from the soil analyses.

FERTILISERS.

When taking samples of artificial manures from bags, the samples must be taken from different bags and at different places of the bag and not only from the top; or the contents are emptied on a heap and mixed up well, and the samples then taken.

The samples sent for analysis should not weigh less than ½ lb., and not more than 2 lb., and should be contained in a clean, dry bottle (lightning jars are very suitable), or stone jar, or in tins with tightly-fitting lids. To each sample must be securely attached a label, giving all the particulars required by the regulations in connection with "*The Fertiliser Act of 1914.*"

In the case of taking samples from a large quantity of manures the following rules should be observed:—

Pick out here and there from the whole of bags or parcels a number of sound, undamaged bags, at the rate of about two or three bags for each twenty, or not less than five bags for a lot of fifty bags and over. The contents of these bags should be emptied on to a clean dry floor, and should be thoroughly mixed with a shovel, taking care to crush any coarse lumps. After being well mixed, the heap should be spread out and levelled down uniformly to about one spade's depth. From this heap at different places

should be taken eight separate small spadesful, which should be mixed again on a clean board or on a large sheet of paper ; and from this small heap three clean dry bottles, stone jars, or tins with patent lids of about ½ lb. capacity should be filled.

All operations must be carried out as quickly as possible in order to avoid a loss or in some cases an increase of moisture in the sample.—QUEENSLAND AGRICULTURAL JOURNAL.

LOW-COUNTRY PRODUCTS AT THE RUBBER EXHIBITION.

R. N. LYNE.

These gave the Ceylon stand its distinctive feature, rubber alone ranged along stands making rather a monotonous show. In some of the other stands notices were posted requesting visitors not to touch exhibits, and such stands consequently were deserted. We allowed visitors freely to examine the things. Products of the coconut palm were the principal feature of the low-country exhibits. We were surpassed by some other countries in the size of nuts, but not, I think, in the quality of copra, though it is necessary to qualify this by saying that the point of view of the manufacturer in judging copra is not necessarily that of the planter. The manufacturer looks for a high percentage of oil, the planter for weight of copra per acre. I encountered this difficulty in a competition in which I was called to arbitrate. Our exhibit of desiccated coconut was very good and complete, new fancy grades being sent to attract the trade. Ceylon is the only coconut-producing country which also desiccates. It is necessary for this product, which is used for confectionery, to be extremely well prepared, as if the slightest rancidity is set up consignments run the risk of being rejected. I had inquiries from the Army and Navy Stores and other buyers for coir fibre brooms, as well as for the fibre itself, which we had no difficulty in disposing of at the close. The floor of the pavilion was covered with coir matting and two large mats sent by MUDALIYAR A. E. RAJAPAKSE. Oils and spices were arranged in exhibition bottles and glass jars on a counter in the middle of the stand with the plumbago.

A very fine wavy hank of Sunn hemp from the Department of Agriculture, hung on the walls of the pavilion, attracted more attention than perhaps any other exhibit. There were frequent inquiries as to price and quantity available, but I was unable to supply details as Ceylon does not produce the fibre in commercial quantities, the plant being grown chiefly by fishermen for cordage. There is an opportunity here for a new product. —REPORT OF THE CEYLON COMMISSIONER.

ENTOMOLOGY.

"INDIAN FOREST INSECTS."

BY E. P. STEBBING.

That Forestry is seriously occupying the minds of the authorities in India is suggested by the recent appearance of a book dealing with Forest Entomology in India. This book, which has been published by order of HIS MAJESTY'S SECRETARY OF STATE FOR INDIA, is written by MR. E. P. STEBBING, late Imperial Forest Zoologist at Dehra Dun and now Head of the Department of Forestry in the University of Edinburgh. The author has had unique opportunity to qualify himself for the work he has undertaken and that he has had first-hand acquaintance with his subject is apparent on almost every page of the book. He recognises the vastness of his subject; and having set out to deal with forest insects generally, found the available mass of material so great that it could not be adequately compressed into a single volume, if the request of the Government of India that the book should be kept within handy reference dimensions was to be complied with. Accordingly he confines himself to the *Coleoptera*, which he points out, is the larger and more important part of the subject. Even thus he has produced a book of some 664 pages with 401 text figures and in addition 63 full-page plates. Nevertheless the author regards himself as "a pioneer endeavouring to indicate in some small degree the line upon which the further study of the subject should proceed." The knowledge of the life-history of many of the insects referred to in the book is still very incomplete and "in the absence of thorough understanding of the life histories it is impossible to attempt to prescribe remedial or protective measures." The author here, we think, renders himself somewhat liable to be misunderstood, for, while the fuller our knowledge of an insect's life-history is, the better shall we be able to deal with it, he must have realised that we can and do prescribe remedial measures in the absence of full knowledge. It is quite true that, in so far as the knowledge is incomplete, just so far are we working in the dark, and it should be our ideal, as it is that of the author, to gain a thorough understanding of the life-history of every insect with which we have to deal.

The region dealt with is the same as that covered by the *Fauna of British India* volumes viz., "India, Burma, including Ceylon." The author expresses the belief that the book should prove of value "to planters and those interested in commercial concerns connected with the growth for profit of rubber, tea, coffee and allied industries." The book is divided into 22 chapters the first five of which deal with general matters, the remainde being devoted to the different families of *Coleoptera*. Chapter I is entitled "A Study of the Distribution of the Insect Fauna of Indian Forests." The author passes in review a number of interesting facts and comes to the conclusion that it is not possible to base a distribution list on (a) the species of trees attacked, (b) the particular zones of vegetation such as hot dry, hot moist, etc.

This is not the strongest chapter in the book. The statement that "the distribution of forest insects is limited more by cold and elevation than by heat and moisture" does not carry us very far. It does not seem to have occurred to the author that the present distribution of the insects is in large measure determined by the previous geological and biological history of the country.

Nevertheless the chapter contains many interesting records, e.g in the Western Himalaya these species of Scolytus infest the deodar and, so far as the author has observed, that tree alone. Yet in Europe the genus is confined to broad leaved trees! Again, the deodar, blue-pine, spruce, silver fir, and long-needled pine have each Scolytid pests peculiar to themselves; yet no such marked limits can be placed on their predators, a clerid preying equally upon all the various species of bark and wood-borers infesting these trees.

Chapter II gives some general remarks on the different methods by which insects attack and destroy tree growth, and on the methods by which insects useful to the forester accomplish their work.

Chapter III and IV should be of considerable interest to the working forester. The former gives some remarks on methods by which the presence of insect pests in the forest may be ascertained and their life histories and modes of attacking trees studied, while the latter deals with the effects in inducing the attack of insects, of *pure woods*, *mixed woods*, *felling operations*, *forest fires*, *windfalls*, etc., and with the methods of preventing insect attacks in the forest and in depots and of combating those taking place.

The suggestions offered for the destruction of pests which oviposit or pupate amongst dead leaves on the forest floor or in the humus or first inch of the soil is that a "leaf-fire" should be run through the infested forest. This seems rather a questionable remedy. Probably the pests would be destroyed, but what of the possible injury to the humus and of the danger of the fire getting out of hand? It should be stated, however, that the author mentions two instances in which such a fire seemed to be effective in destroying larvæ, pupæ, etc.

Chapter V gives briefly a synopsis of the characteristics of the order of *Coleoptera*, two diagrams giving a key to the nomenclature of the external morphology. In the remaining chapters short notes are given on specific insects under the head of Habitat, Trees attacked, Description, Life History, Relation to the Forest and, where practicable, Remarks on Protective and Remedial Measures. In many cases—and one wishes they could have been more numerous—descriptions of the larval as well as of the adult insect are given.

Before proceeding to give a resumé of the discussion of one such insect we should like to call attention to what seem to us to be blemishes in an otherwise admirable book. The author at times is somewhat more slip-shod in his language than is his wont. He speaks, no doubt inadvertently, of the coccid *Monophlebus* as one of the Aphidæ. He is not very sure whether he should use cerambyx or cerambycid, chalcidæ or chalcididæ; he even speaks of "chrysomelidæ beetles." He speaks of "hymenopterous fly," "lepidopterous cutworm," and "coccid scale insect." He refers to the

aphid as "taking its sustenance through a soft tubular beak," and does not seem to recognise that an Ichneumon may drill a hole in which to oviposit independently of the existence of a crevice.

Then he has a penchant for the use of the definite article and speaks almost consistently of "the Pinus longifolia," "the Sirex imperialis," "the Chermes himalayensis," and even of "the Artocarpus."

Two typographical errors that have come under our notice in a cursory reading should be mentioned, viz. *Zeuzera coffaea* for *Z. coffeæ* (page 12) and *Dichrocosis* for *Dichocrocis* (page 17).

As giving an illustration of the method of treatment of each insect we shall take that of *Batocera rubra*, L. which is known in Ceylon as a root and stem borer of Hevea. Its distribution is given as Baluchistan, Dehra Dun Pusa and its host plants as *Ficus cariea*, (Fig) and *Mangifera indica* (Mango). Thereafter follow descriptions of the beetle and its larva. The length of the full-grown larva is given as $3\frac{1}{4}$ in. (against the 2 in. to $2\frac{1}{2}$ in. given by GREEN in Bulletin No. 2 of Department of Agriculture, Ceylon. I have seen one $3\frac{1}{4}$ in. long.) Under the head of "Life History in the Fig tree in Baluchistan" it is stated that the beetle commences to issue from the trees about the middle of June and is found throughout the remainder of the month and on through July. (In Ceylon the beetles are on the wing in July and again in October). The eggs have not been observed. The grubs feed at first in the green sappy parts of the inner bark and afterwards tunnel down into the wood and bore down the centre of the stem or branch. The tunnel is blocked behind by the excreta of the larva, the portion occupied by the latter being full of sap. In its progress down the stem or branch it eats out at intervals offshoots to the outer bark, these probably serving to admit air into the stem. The sap oozing from these is an indication that a grub is at work inside the stem. The larger branches and the main stem of the fig tree, including the bottom portion of the stem and the upper thick portion of the root are the parts of the tree infested. When full fed the grub pupates in the heart of the stem or in the upper part of the root. Three to three and a half months are spent in the pupal stage. The beetle when mature bores a circular tunnel straight to the outside of the tree, the large exit hole being very visible on the trunk. Up to the present it has not been definitely proved that this pest kills the fig trees. Badly attacked trees are very liable to fall or to be blown over. Reference is made to LEFROY'S observation on this insect in "Indian Insect Pests," which is to the effect that at Pusa the larvæ and pupae were found under the bark of trees. Under the head of "Protection and Remedies," the following recommendations are made :—

(1) Badly infested trees should be cut out and burned, the period of cutting being between the end of October and the end of March.

(2) When a tree is not seriously infested, attacked branches or portions of the main stem, if high up, should be pruned off and burned, the pruned spot being thickly coated with tar. In this connection the very practical suggestion is made that in cutting off large branches the branch should first be sawn off about a foot from its junction with the stem, the remaining portion being subsequently taken off flush with the stem ; this to avoid the risk of the weight of the branch tearing the bark off the trunk.

(3) From beginning of June to end of August infested parts should be enveloped in muslin or mosquito-netting bags to catch the emerging beetles. The traps should be inspected daily.

(4) Between the dates specified in the preceding section a careful watch should be kept for beetles that have escaped. They will usually be found clinging to the bark of trees in the day time.

The above resumé will give some idea of the scope of the book.

It is not correct, so far as the reviewer is aware, to say that *Xyleborus fornicatus*, Eich. has caused destruction to *cacao* plants in Ceylon.

An index to the trees, as well as to the insects is included. This is a book which should be on the table of everyone in charge of forest products. Its price is fifteen shillings and it is sold by the Agents for Indian Government publications.

A. R.

THE DAMPING OF SEEDLINGS.

Any suggested remedy for this annoying experience is to be welcomed. We have heard of sterilization by means of heat and also the use of formalin (1 to 50 of water) recommended; also sulphuric acid (1 oz. to a gal.), but these agencies involve expense and call for careful manipulation.

The results of certain practical tests (referred to in the AGRICULTURAL NEWS of November 21st) undertaken with the same object in view go to indicate that two methods of treatment gave very satisfactory results. These were (1) Over 6 in. top soil replaced by sterile clay subsoil, and (2) Quarter inch of fine gravel over soil. The record in both these cases was "practically free."

The worst effects followed from over-watering, shading and the presence of organic matter in the soil.

The use of a subsoil dressing indicates the advantage of the sterile condition associated with a subsoil and non-liability to infection owing to absence of organic matter.

It is to be presumed that artificially sterilized soil is more liable to reinfection than a normally sterile one.

It is suggested that where fuel is plentiful the common method of surface burning (as is usually done for tobacco seedlings) might be adopted with advantage.

The use of fine gravel or sand for the seed bed is certainly a very economical means of meeting the difficulty, provided the necessary material is easily obtainable.

C. D.

LIVE STOCK.

RINDERPEST IN EAST AFRICA.

THE EFFECTS OF SERUM.

Capt. C. A. Neave, Chief Stock Inspector.

This disease has been prevalent among the northern Masai cattle for several years past, and had become practically enzootic among them, breaking out periodically each year and being confined mainly to the young stock, that is to those born since the last visitation of the disease to any particular manyatta, the majority of the full grown animals being immune.

The disease broke out in a mild form in a few manyattas among the young stock during April, May and June. These outbreaks were dealt with by serum inoculation of the susceptibles and so stamped out before the implicated manyattas were allowed to move. During September the disease appeared in several further manyattas west of the Narok, at Thomson's Falls, among several manyattas then being collected in readiness for starting for the Southern Reserve, and in others near Rumuruti; also in some 28 manyattas to the north-west of Rumuruti in the neighbourhood of Bani Bani Salt Lick. Serum inoculation of the supposed susceptibles was resorted to in the case of those near Thomson's Falls and near Rumuruti, but as many of these manyattas had not had the disease for a considerable period it was found that in many cases animals up to two and three years of age and even older were susceptible, and the disease was so widespread as to be beyond our powers to cope with by the serum method. By October the disease was prevalent in manyattas containing no less than 60,200 head of cattle.

The procedure I adopted was to distribute the manyattas according to their state of infection into different areas for observation, afterwards moving them from one area to another in accordance with the progress of the disease, and with a view to the best grazing and water for them. The most highly infected were placed (1) in the triangle formed by the Narok and Mutara Rivers and the Nyeri Road, and (2) at Sugota Looltian from Thomson's Falls to south end of Olbolossat; those dealt with by inoculation were kept near Rumuruti; those convalescent were distributed among the Aiyam River, and as they became clean were moved to the neighbourhood of Kampi Kofia, Suputio Sereko and other uninfected places, in readiness for the next move.

The course of the disease varied greatly in different manyattas, both in regard to the time it took to go through a manyatta and the severity of its attack.

The manner in which the Masai mass their cattle together in their bomas every night for the twelve hours, from sunset to sunrise, would seem exceptionally favourable for the rapid spread of such a disease as rinderpest through the whole manyatta, but in many cases it would be found that the

disease lingered on for several months before dying out, and on some occasions after being quite clear for two or three weeks the disease would flare up again after the manyatta had been moved to a new and clean location, and, beginning probably in a young calf, afterwards affect half-grown animals that it had been supposed must surely have passed through it already.

In other cases a manyatta would get the disease through them as rapidly as could be wished and clear up equally quickly.

It was found advisable to move a manyatta to a fresh location as soon as possible after it appeared that the disease was finished, in order that newly-born calves should not have an opportunity of contracting the disease in the previously infected boma.

Before the last manyattas were sent down, all such calves as had not already had rinderpest were given a dose of anti-rinderpest serum before leaving, and fortunately all reached their destination without further outbreak.

As regards the severity of the disease, in certain manyattas this depended, in a large measure, on the length of time that had elasped since the last visitation of the disease on them—the longer this period the larger the number of susceptible animals. One manyatta in particular in the Sugota District had succeeded, by the exercise of great care and much travelling in the outlying districts during the last big outbreak of rinderpest, and for several successive years, in avoiding the disease, with the result that practically the whole of the cattle were susceptible. This manyatta contracted the disease during October and cattle of all ages became affected, with a larger percentage of deaths than any other in Laikipia.

The majority of the Masai have had the disease nearly every year, and such people had no desire to escape it this year, being, on the contrary, quite willing to pay the necessary toll in young stock in order to have the survivors immune. It seems certain that in several instances they have purposely introduced the disease into their young stock with this object in view.

However, in certain other manyattas which had escaped for a couple of years or so, the disease was looked upon in a more serious light, the number of susceptibles being so much larger. This was certainly the case with the manyattas in the pleuro-pneumonia area, which, by having been segregated for some time, had escaped the disease for several seasons and the elders were equally more apprehensive of it. Moreover, it was observed that the percentage of recoveries was considerably higher in the young stock than among the older animals; but in my experience during the past year the number of recoveries among the animals of all ages has been surprisingly great, and judging by frequent counts of the cattle in infected manyattas, the birth rate has considerably exceeded the death rate, i.e., the number of cattle has increased in spite of the disease.

A very frequent symptom of this disease among the Masai cattle, which I have not seen recorded previously, was the appearance of a tumour at the base of one or both ears, which usually bursts into the ear, discharging a large amount of purulent material. This, together with the mucous discharge from the eyes and nostrils, probably accounts for the Masai belief that the disease enters the animal by the ears, eyes and nose.

The CHIEF VETERINARY OFFICER has the following note on the subject :—

It is difficult indeed to estimate, even approximately, the mortality which has taken place during the past year through the ravages of cattle plague, and there are few districts of the Protectorate which have been totally free from its invasion.

Among the Masai herds the mortality has been comparatively small, for a large number of their animals show a resistance to the disease, due to the fact that at each visitation of rinderpest the Masai endeavour to convey it to their herds, as they know full well that should their young stock escape infection they will be possessed of large numbers of cattle highly susceptible to the disease.

The most serious outbreak has been at Nandi and in tha Lumbwa District, and the arrival of infected cattle from Uganda at Kisumu made it necessary to forbid the importation of cattle from Uganda unless actively immunised before their exportation.

In many districts the disease has had to run its course, as owing to the smallness of the veterinary staff it was impossible to cope with its rapid spread.

In the Rift Valley and on the Uasin Gishu Plateau among the high grade stock small outbreaks have occurred, but I am glad to say that the free use of anti-rinderpest serum prevented these outbreaks from causing a heavy mortality or assuming alarming proportions.

The disease is still prevalent in the eastern provinces of Uganda, and it has spread south beyond the borders of the East Africa Protectorate into German East Africa, where DR. WOELFEL informs me it has assumed a more virulent course.

Viewing the disease from past experience there can be no doubt that our knowledge of some phases of rinderpest pathology is sadly deficient. Its benignity in some cases and its malignance in others, its rapid spread in some outbreaks and its attacking only a case here and there in others, are questions demanding field and laboratory experiments; and when the results of these experiments are collated I feel certain that the pathology of rinderpest will require considerable revision.

The strains of the disease are so varied and inconsistent that the standardization of virulent material has been most difficult, and has made the adoption of a safe method of active immunisation so far impracticable for universal application.

It is true that the virulent material which has been passed through successive generations at the laboratory is of a constant strain, and that were it possible to transport the blood to distant portions of the Protectorate the active immunisation of cattle could be undertaken, but until experiment proves how this rinderpest blood can be conveyed to centres for inoculation purposes the active immunising of cattle against the disease must be fraught with danger and disappointment.

Every endeavour is being made to elucidate this factor, and it is very sincerely hoped that we shall shortly be in a position to undertake the double inoculation. At present our energies, together with large quantities of serum, are being used in the futile work of conferring a passive immunity of about

14 days duration. Until, therefore, we can arrive at some safe method of conferring a life long immunity, we must anticipate having rinderpest to deal with in this Protectorate.

It is the general desire among settlers to have their cattle actively immunised, but in view of the disastrous effects of the double inoculation on two farms 18 months ago, I am extremely diffident in carrying out double inoculations in the field until such time as we can safely guarantee a loss of not more than 5-10 per cent. to the farmers.

At the laboratory where serum and virulent blood of known quality are in constant use in the manufacture of rinderpest serum, the death-rate is well under 5 per cent.

From the Veterinary Pathologist's report it will be seen that 123,540 doses of anti-rinderpest serum have been produced during the past 12 months. There have been issued 79,713 doses, and 4,978 doses have been distributed to settlers as reserve in case of a sudden outbreak on their farm, or for the inoculation of their transport animals while trekking through infected areas.

39,674 doses have been sent to German East Africa, Uganda & Nyasaland.

Dr. Woelfel, Acting Veterinary Officer, German East Africa, informed me that he had considerable success in active immunisation of cattle with the use of our serum. The success attending the double inoculation in German East Africa may be due to the fact that they were dealing with a virulent material of invariable strength.

The product of anti-rinderpest serum in this Protectorate has been dependent upon the supply of susceptible stock from Uganda. The western provinces of Uganda have so far remained clean, a fact probably due to the River Nile and chain of lakes forming an effective quarantine barrier between the clean and highly infected Eastern Province.

There is estimated to be some 500,000 head of cattle in the clean areas of Uganda and every endeavour is being made by the veterinary staff of that Protectorate to prevent extension of the disease to these, hitherto, clean grazing grounds.

For many years these areas have been free from rinderpest visitation, and should the disease now obtain a foothold it would assuredly spread with great rapidity.

These clean areas are further threatened by invasion from the south, for in German East Africa there are areas of infection to the south end of Lake Victoria Nyanza. It is true most of these areas are bounded by tsetse fly belts of great extent, and while such belts would prevent the native from driving his cattle across them, it is to be remembered that these fly zones contain large herds of buffalo which are liable to migrate further north on the approach of the disease.

It behoves us, therefore, to take time by the forelock and make every endeavour to have such a reserve of anti-rinderpest serum as will enable us to combat the disease in our own Protectorate and to help Uganda, Nyasaland, German East Africa and the Colonies of South Africa.—Annual Report of the Department of Agriculture, British East Africa.

THE ANGORA GOAT.

L. L. HELLER.

The value of the 1909 clip of mohair in the United States was $901,597, that is nearly four times as much as in 1899. The number of fleeces of mohair rose from 454,932 in 1899 to 1,682,912 in 1909. Of this latter number 1,077,463 came from Texas, 155,980 from New Mexico and 141,588 from Oregon ; Arizona and California each contributed upwards of 100,000 and Missouri was the only other State with over 20,000. The average weight per fleece was 3·7 lb. in Oregon and 1·85 lb. in Texas. In the latter State many Angora goats are shorn twice a year, for which reason the yield of mohair per head is undoubtedly above the census figure for the average weight per fleece in the State. Assuming that one-third of the Texan Angoras are shorn twice it would appear that in the United States the total number of Angoras of shearing age was about one million:

During the last few years the breeding of these goats has increased in importance more than that of any other animal and it is now carried on in almost every one of the States. Conditions are especially favourable to this branch of animal husbandry in the North-West, in which brush is so abundant, and where the Angora goat contributes greatly to the control of forest fires by clearing brush lands. American Angoras have hitherto been exported mostly from California to South Africa, Canada, Alaska and recently also to Brazil and the Argentine Republic. The first Angoras introduced into the Union were mostly crossed with common goats in order to obtain a larger and hardier animal. The first and second crosses showed but little mohair and much kemp, and five or six crosses with pure Angoras were necessary before a really superior animal was obtained. After the fifth cross the product could be considered as pure bred Angoras. The writer does not consider it advisable to cross with common goats in order to obtain Angora flocks. He considers it better to import good original animals and to keep them pure from other strains.

The Angora goats of the United States are generally pure white and horned. Their ears are either partially erect or drooping. Their bodies denote a good constitution ; they are symmetrically built, and with the exception of the inside of the upper part of the legs they are well coated with fleece. The demand is for fine quality, closely curled, very glossy fleeces and as nearly as possible free from kemp.

The price of mohair has of late years much increased in the Union owing to the many usages to which it is put (manufacture of plush, overcoats, wigs, etc.). The weight of fleece for American Angoras ranges between 2 and 12 lb. The fleece of a one-year old goat weighs 2½ lb. Where the fleece is allowed to grow for 12 months the average length of the staple is about 10 inches. The total weight of the fleeces produced in the United States in 1913 amounted to nearly 5,000,000 lb. The best of it comes from the North-Western States. The average cash production of a goat is, according to the NORTH-WEST ANGORA GOAT ASSOCIATION, $2·25 per annum. Besides this considerable home production, the United States import, in round numbers, about 2,000,000 lb. of mohair, which is on the average superior in quality to the American produce.

The loss of weight in washing off the home hair is about 12 to 15 per cent., rather than that of the imported article. The skins of Angora with the hair attached are sometimes tanned in the United States and are much used for rugs, carriage robes, etc. The flesh finds a ready market especially in Kansas City. The average weight of the goats slaughtered there is about 68 lb.

Shearing takes place from February to March and the second clip in September or October in the South-West, and from March to April in the rest of the country.

The most important Angora breeding Associations are the AMERICAN GOAT BREEDERS' ASSOCIATION, the NATIONAL MOHAIR GROWERS' ASSOCIATION and the NORTH-WEST ANGORA GOAT ASSOCIATION.—MONTHLY BULLETIN.

CO-OPERATION.

CO-OPERATIVE SOCIETIES IN INDIA.

The report of the Registrar of Co-operative Societies in the Central Provinces and Berar in India on the working of the Co-operative Societies for the year 1913-14 is an important document for those interested in the movement. The course of the year has been marked not only by poor harvests in some of the districts but by the commotion of the financial crisis, a sudden restriction of commercial credit and the disturbance of public confidence in ordinary banking concerns. Yet during the year the co-operative movement made steady progress.

The number of Societies increased from 1,449 in 1912-13 to 2,213 during the year under review, and the number of members rose from 28,396 to 42,222. The working capital of the Societies has increased during the year from Rs. 3,515,046 to Rs. 6,509,938. The year's turnover amounted to Rs. 21,171,706 —an increase of Rs. 8,476,496 from the last year. The reserve fund of all the Societies now has reached little over two lakhs and the steady increase of this fund is shown by the following table :—

On 31 March, 1912.	On 30 June. 1913.	On 30 June, 1914.	On Sept. 15, 1914.
Rs.	Rs.	Rs.	Rs.
34,484 ...	59,250 ...	128,311 ...	203,517

Loans have been given to members for diverse purposes, illustrating how useful a purpose has been served by the movement. 40·24 per cent. of the funds of the societies have been employed in the purchase of bullocks, 24·01 per cent. in the repayment of old debts, 10·92 per cent. in the purchase of seeds, 3·80 per cent. on sundry agricultural expenses such as weeding, 2·94 per cent. for the purpose of land improvement, 1·38 per cent. in the purchase of land, 0·24 per cent. in the construction of wells, 0·37 per cent. in the payment of rent, 13·79 per cent. for industrial purposes such as purchase of carts, ponies, yarn, metal, silk, etc., 1·08 per cent. for the purchase of domestic necessaries, such as food, clothes, etc., 0·73 per cent. in marriage expenses, and 0·50 per cent. in construction of houses.

Of the societies the Central Banks have made very satisfactory progress, and in spite of adverse conditions they have met their obligations to the Provincial Bank punctually and in full, and they have been able to collect considerably more than the actual amounts due for recovery. Reserve fund has doubled and savings on deposits by the members of the small village societies have shown a substantial increase.

Among societies for purposes other than agriculture there are two Cattle Breeding Co-operative societies and one or two societies of Dairying. Of the two former societies one has a membership of 20 farmers who have entered 60 cows, 1 bull and 38 young stock. All the cattle above six months

and below 12 years of age have been insured against diseases and accident. The other society was only registered in May, 1914, and is reported to be making very satisfactory progress. These two societies have at their disposal, given by Government, pasture lands to the extent of 492 and 269 acres respectively.

The Dairying Society has 13 members possessing 72 buffaloes, 54 cows and 90 young ones. The total quantity of milk, butter and cream distributed by the society was 149,898 lb., 109 lb. and 139 lb respectively. The total profit made during the year was Rs. 3,117-10-8. The members have been helped by Central Banks with loans, and it has been proposed to borrow Rs. 1,600 more for the purchase of more milch cows.

The following rules have been adopted by the Cattle Breeding Societies for the guidance of members :—

(1) There will be one or more stud bulls owned by the society. They will be selected and passed under the orders of the Deputy Director of Agriculture. When past work they will be sold and the proceeds credited to the Society's account.

(2) The entire treatment, care and distribution of the services of the bulls will be under the control of the Committee of five persons, as laid down by the Society's by-law 7.

(3) A herd register of cows and calves will be maintained by the Committee. In it will be entered only those cows, the private property of members, which have been selected and passed under the orders of the Deputy Director of Agriculture as fit for breeding purposes, and calves out of such cows by the stud bull.

(4) All cows entered in the herd-register must be kept continuously on the pasture land of the society.

(5) Not more than 60 cows in all will be permitted to be registered, of which not more than six may belong to any one member.

(6) None but registered cows will, under any circumstances, be permitted to enter the pasture area of the Society.

(7) The services of the society's bull will be conclusively reserved for the registered cows. But, in default of registered cows, its services may, under the special orders of the Committee, be hired out for the use of unregistered cows, preferably those belonging to members of the society. But no record will be kept in the herd-register either of such services or of the young stock so produced from unregistered cows.

(8) The entire treatment and control of the registered cows will be with the Committee, who will also have absolute discretion in regard to their expulsion from the pasture area or exclusion from the register.

(9) A serving fee of Re. 1 for each cow will be paid by the owner of the cow to the funds of the society.

(10) A grazing fee of Re. 1 for each cow, and Re. 0-8-0 per annum for each calf, admitted to the pasture area will be paid by the owner of the cow or calf to the funds of the society. In addition to this all charges incurred by the society in the feeding and treatment of the cows and calves must be defrayed by the owners as the Committee may direct.

(11) All calves will be the private property of the owner of the cow which bears them. Those born from registered cows will be duly registered. But the owner will be at liberty to remove his calves from the pasture area at any time or dispose of them in any way he pleases provided that if he contravenes the advice of the Committee in regard to their treatment, the Committee will have full power to expel any calf from the pasture area or to strike it off the herd-register.

The Registrar says that the attitude of the general public towards co-operation has continued to be encouraging and friendly ; but there has been much opposition, covert and otherwise, from those who do not desire to see the movement succeed and are prejudiced against it. The second Provincial Conference has been held in September and has been opened by the Hon'ble the Chief Commissioner. As a whole the report is encouraging and satisfactory and speaks well for the good work done by the Registrar and his co-workers.

N. W.

THE VALUE OF WIND BREAKS.

Wind belts are usually only considered necessary to break the force of the wind which often causes serious damage to crops by blowing them down or (in the case of perennial trees) breaking them across. It is also well known that plants which are grown on wind-blown situations do not thrive.

DR. HALL recently referred to the effect of wind in promoting evaporation of moisture from the soil, and the AGRICULTURAL NEWS (W. Indies) suggests the advisability of an enquiry as to whether windbreaks could not be utilized more extensively in connection with arable cultivation as a means of reducing evaporation.

C. D.

OIL SEEDS.

The INDIAN TRADE JOURNAL refers to the kernels of two oil seeds under the name of "Raina" and "Panang." The latter is known as *Amoora Rohituka* (S. Hingul), and the former *Calophyllum inophyllum* is the familiar "Domba." The products were submitted to the Imperial Institute in order that their composition and commercial value might be ascertained. The technical trials were carried out by a firm of oil-seed crushers in London, who state that the oil from the "Raina" seed ought to find a ready sale at a moderate price for soap-making: but the residual cake is practically useless. The seed was nominally valued at £9 per ton in April 1913 in the United Kingdom. "Panang" oil, though not edible, is an excellent soap-making material; the residual cake is suitable for manure but not as a feeding-stuff. The kernels were nominally valued at £1 per ton in April 1913 in the United Kingdom; and the residual cake at about £2 per ton.

C. D.

GENERAL.

THE ART OF RUBBER EXPERIMENT.

For some time past rumours have been periodically wafted to Ceylon of a new discovery, which has rendered all previous tapping experiments valueless. The discovery has been considered so important that it has been thought advisable not to confine it to the obscurity of a private report, and consequently the plantation rubber world at large has been informed of the error of its advisers in an elaborate article in the INDIA RUBBER JOURNAL, entitled "The Influence of the Skill of the Tapper," by MR. SIDNEY MORGAN. The discovery is neither more nor less than the fact that some tappers can get more rubber from a given tree than others.

It is always interesting to trace the recurrence of ideas in any subject and in no subject is this recurrence so marked and so frequent as in Tropical Agriculture. This recurrence of ideas is by no means a bad thing, provided that each return denotes some advance in treatment, or some addition to our knowledge of the subject. The idea in the present instance is one which was a commonplace to former generations of visiting agents, planters and experimenters, though it seems to have taken some of the present generation by surprise.

But MR. MORGAN, no doubt, does not contend that the discovery is a new one, but that, though the fact was well known, it had not been demonstrated by an exact experiment to what extent the difference in the skill of the tappers might be operative. Accordingly he has devised and carried out an experiment for that purpose, which is "beyond criticism."

"In the experiment 15 lines of trees were taken and 15 coolies were chosen, all of whom were good tappers, as far as one could judge..... On the first day each cooly tapped one of the 15 lines of trees, and on every successive tapping day each cooly was moved along to the next row.....

"It is plain that at the end of a period of 15 tappings each cooly will have tapped the whole 15 lines of trees once. Thus, given any but very bad weather conditions, at the end of 15 tappings each cooly has had the opportunity of bringing in the same quantity of latex, seeing that all coolies have tapped all the same trees an equal number of times. Provided all the tappers were equally skilful all should bring in the same amount of rubber."

The foregoing statement would no doubt be assented to by the majority of rubber planters. But it is not correct. There are at least two factors to be taken into consideration, apart from the skill of the tapper. In the first place, the rows of trees are not likely to be of equal value as rubber producers. MR. MORGAN states that "any difference between the growths of the several lines did not matter," as each cooly tapped every row during the 15-day period. In the second place, the yield of a given tree is not a constant quantity, but varies almost at every tapping, being dependent both on external and internal factors. And as these factors may differ in the case of different trees, the daily variations in yield are not of the same degree in all the rows of trees. A glance at the results of any experiment, where the same tapper taps all the trees and the daily yields of the trees are tabulated separately, will demonstrate that point. MR. MORGAN assumes as an axiom that the same tapper will always obtain the same amount from a given tree

Let us take the case of three rows of trees, and three tappers of equal skill. Let the daily ideal yields of the three rows, that is, the yield obtainable by a good tapper on the best possible day, be represented by a, b and c respectively. Let the daily variation factors for the three tapping days be m, n and o ; and to simplify matters we will suppose that the degree of variation is the same for all the trees on the same day. Then on the first day, cooly No. 1 taps the first row and gets *ma* lb., cooly No. 2 taps the second row and gets *mb*., cooly No. 3 taps the third row and gets *mc*. On the second day, cooly No. 1 taps the second row and gets *nb*., cooly No, 2 taps the third row and gets *nc*., while cooly No. 3 taps the first row and gets *na*. On the third day, cooly No. 1 taps the third row and gets *oc*., cooly No. 2 taps the first row and gets *oa*., while cooly No. 3 taps the second row and gets *ob*.

The total yields are then as follows :—

Cooly No. 1 = ma + nb + oc
Cooly No. 2 = mb + nc + oa
Cooly No. 3 = mc + na + ob

If these three quantities are equal, we have two equations with six variables. The number of possible solutions is therefore indefinite. The simplest cases are (1) that a, b, and c are equal, i.e., the rows of trees are identical in potential yield, or (2) that m, n and o are equal, i.e., that each row would give the same yield every day. MR. MORGAN states that the first of these conditions does not matter. He must therefore assume that the daily yield of a row is independent of the external and internal conditions of the trees.

Even if no other figures were available, the published results of the experiment would show that this assumption is unwarranted. The experiment was carried on for five periods of 15 days each, and the yield obtained by the best tapper varied from 40 lb. in the second period to 70 lb. in the fourth period. We are not told whether the trees were tapped daily, or whether the periods were continuous. If both these conditions were fulfilled we have a variation from 40 to 70 in 45 days. Unfortunately we have no definite information as to the course of this fluctuation as MR. MORGAN makes the very common mistake of having no control experiment.

For those who have no time to devote to the study of the algebraic proof given above, the following illustration may be of assistance. Suppose one of the rows is a good row, and at its best gives 7 lb. a day, while another row is a bad one and gives only 3 lb. a day. Suppose also that there comes a day when owing to external conditions, etc., the trees are only yielding half their best. Then the cooly who taps the good row on that day will lose $3\frac{1}{2}$ lb. from his possible total, while the cooly who taps the bad row will lose only $1\frac{1}{2}$ lb

Attention may be drawn to another point which should have called for more thought before publication. The experiment presupposes that a given cooly will always get the same relative result during each period. Yet cooly D's positions in the order of merit for the five separate periods are 1, 5, 5, 12, 12. Similarly cooly F takes the places 1, 7, 10, 5, 5 ; and cooly H, 7, 5, 5, 15, 12. It is not legitimate to smooth out discrepancies of this kind by averaging the results. If differences of this degree are of no significance in the case of the individual cooly, how can they be regarded as significant between different coolies ?

MR. MORGAN's statement that different tappers will get different results from the same trees is correct, but his experiment does not afford a demonstration which is "above criticism."

MR. MORGAN sees several advantages in the plan of rotating the tappers, as described above, in an ordinary tapping experiment. In the first place he states that it is not necessary to have the same number of trees per row. But

that is not necessary in any case. In the second place, he remarks that it does not matter whether the trees are of exactly uniform growth or not. But surely, in an experiment, say, to test the relative value of daily, as against alternate day, tapping, it would be necessary to have the two blocks as nearly equal as possible.

The foregoing relates to the actual experiment described. When, however, MR. MORGAN begins to deduce conclusions he goes considerably further than his knowledge warrants. "The significance of these results in their bearing upon tapping experiments cannot be insisted upon too strongly. .....In small experiments employing only hundreds of trees (*sic*), it will be seen that the effect of the degree of skill might well be very considerable; and this applies to all experimental results hitherto published, as far as the writer's recollection serves him, as there are no records of any experiment (? to demonstrate the difference in the skill of the coolies—T. P.) conducted on a large scale." At the close of his article, MR. MORGAN drops the qualifying clauses, and states. "The deductions made from results of tapping experiments previously recorded may be considerably discounted on account of this factor of personal skill which has been neglected hitherto."

Now, this is not the case. The rubber tapping experiments at Peradeniya are arranged in comparable sets, and one tapper taps each set. Thus one tapper taps all the trees under manurial experiments, another taps the series, alternate days v. daily in alternate months, and so on. If the number of trees is large, this will introduce an error by prolonging the daily time of tapping, so that the trees tapped last will yield less than they should, but this can be avoided to some extent by changing the order of the tapper's round periodically.

This brings us directly to another fallacy which underlies so many of these more pretentious experiments. The material experimented upon in a field experiment is not homogeneous, the weather and soil conditions cannot be controlled, and therefore many causes are at work of which the experimenter has no knowledge. All these may influence the result to an unknown extent. This is not a condition peculiar to the Tropics, but one which is met with in agricultural experiments everywhere. Now, the natural impulse of the untaught experimenter is to try to get rid of this unavoidable source of error, as far as is humanly possible, by increasing the size of the plots under experiment. It is no new thing. It has been done times innumerable. But it has now been amply demonstrated that increasing the size of the plot does not get rid of the "experimental error." This knowledge has now become established in England. One can get rid of, or rather learn the magnitude of, the experimental error by increasing the number of plots, but not by merely increasing the size of the plot. The particular size of plot which is best fitted for any given experiment depends on the character of the crop, and is conditioned by such questions as the influence of boundaries, etc.

An experiment which deals with the relative yields of two blocks each containing 250 trees is no more accurate than one which deals with two blocks of 25 each. Indeed, it is more likely to be inaccurate, owing to the difficulty of control. This is exemplified by the experiment dealt with in this article, where the fifteen rows and fifteen coolies have produced a mass of detail which obscures the underlying error. "Oh, but," it is objected, "it you only take 25 trees there may be 10 bad trees among them." Well, consider the case of a row of 100 trees. If we take 25 there may be ten bad trees. Which 25? The first, or the last, or the middle? If the probability is that there are ten bad ones in twenty five, it is equally probable that there will be forty bad ones in the hundred.

To avoid the differences produced by the unequal skill of the tappers, one must take small numbers of trees so that one tapper can tap them all reasonably early in the day. If an experimenter has at his disposal a great number

of trees of even growth, and a corresponding supply of tappers, he will get results in a shorter time by taking more, *but they must be taken in the proper way. It is of no advantage whatever to lump them into big blocks.* Instead, they should be divided up into small blocks of about twenty each, as equal as possible, and each tapper should carry out the whole experiment on as many blocks as is necessary. For example, in testing daily v. alternate day tapping, each tapper would tap two blocks, one daily and the other on alternate days. *Each tapper's results must be kept separately.* Given 500 trees, they could be divided into twenty blocks of 25 trees each, and these would give ten pairs or ten duplicates of the same experiment. Ten separate results would then be obtained each year, and from these the probable truth of the experiment could be calculated. With an experiment of this character, almost as much could be learnt in one year as in ten years in the present way.

Accuracy in agricultural experiments is obtained, not by increasing the size of the plots under experiment, but by repeating the experiment year by year, or by increasing the number of plots under experiment, each plot being treated as a separate entity. This has been understood in Java, where a manurial experiment has been established, which requires eight plots for the series. There are 336 trees under experiment, but they are not arranged in eight blocks of 42 each. The whole field is divided into blocks of four trees each, and each manure is applied to 10½ blocks. There will thus be eleven sets of results, and from these the "probable error" of the experiment can be calculated and allowed for. However one may view the plan of taking four trees as the unit, the *method* of the experiment is undoubtedly the correct one.

T. PETCH.

CEYLON LEECHES.

A. E. SHIPLEY, Sc. D., F.R.S.

In the Further East we come across another species of leech even more injurious to mankind than *Limnatis nilotica*. This Asiatic leech is known as *Hæmadipsa zeylanica*, and is one of a considerable number of leeches which have left the water and live on land.

From India and Ceylon, throughout Burma, Cochin China, Formosa to Japan, the Philippines, and the Sunda Island, this terrible, and at certain elevations ubiquitous, pest is spread. It lives upon damp and moist earth. The family to which it belongs is essentially a family which dwells only in the uplands and shuns the hot, low-lying plains. Its members do not occur on the hot, dry, sandy flats. TENNANT has described the intolerable nuisance they are in Ceylon. They are in fact of the many visible plagues of tropical Asia and its eastern islands perhaps the worst. Yet few have recorded their dread doings, and those few have escaped credence.

Each specimen of *Hæmadipsa zeylanica* is of a clear brown colour with a yellow stripe on each side and with a greenish dorsal stripe. There are five pairs of eyes, of which the first four occupy contiguous rings; but between the fifth and seventh ring there are two eyeless rings interposed. As in the medicinal leech there are three teeth, each serrated like a saw.

In dry weather they miraculously disappear and nobody seems to know quite what becomes of them, but with returning showers they are found again on the soil and on the lower vegetation in enormous profusion. Each leech is about one inch in length and is about as thick as a knitting-needle. But they contract until they attain the diameter of a quill pen or extend their bodies until they have doubled their normal length. They are the most insinuating of creatures and can force their way through the interstices of the tightest-laced boot, or between the folds of the most closely wound

puttees. Making their sinuous way towards the human skin, they wriggle about under the under-clothing until they attain almost any position in the body they wish to take up. Their bite is absolutely painless, and it is usual for the human sufferer to become aware that he has been bitten by these silent and tireless leeches when he notices sundry streams of blood running down his body when he at last has the opportunity of undressing.

Sometimes, as TENNANT's figure shows, these land leeches (*H. zeylanica*) rest upon the ground. At other times they ascend the twigs of herbs, grasses, and especially the leaves of the forest undergrowth. Perched upon the ends of growing shoots, leaves and twigs, stretching their quivering bodies into the void, they eagerly watch and wait the approach of some travelling mammal. They easily "scent" their prey, and on its approach advance upon it with surprising rapidity in semi-circular loops. A whole and vast colony of land leeches is set in motion without a moment's delay, and thus it comes about that the last of a travelling or prospecting party in a land-leech area invariably fares the worst, as these land-leeches mobilize and congregate with extraordinary rapidity when once they are warned of the approach of a possible host, but not always in time to engage in numbers the advance guard.

Horses are driven wild by them, and have poor means of reprisal, They stamp their hooves violently on the ground in the hope of ridding their fetlocks of these tangled masses of bloody tassels. The bare legs of the natives who carry palanquins are particularly subject to the bites of these blood-thirsty brutes, as the palanquin-bearer has no free hand to pick them off. TENNANT writes that he has actually seen the blood welling over the boots of a European from the innumerable bites of these land leeches, and it is on record that during the march of the troops in Ceylon, when the Kandyans were in rebellion, many of the Madras sepoys, and their coolies, perished from their innumerable and united attacks. It is also certain that men falling asleep over night in a Cingalese forest have, so to speak, next morning "woke up dead." These sleepers have succumbed during the night to the repeated attacks of these intolerable and insatiable pests.

DR. CHARLES HOSE, for many years Resident at Sarawak, has told me that on approaching the edges of woods in Borneo you can hear every leaf rustling, and this is due to the fact that the eager leech, perched on its posterior sucker on the edge of every leaf in the undergrowth, is swaying its body up and down, yearning with an "unutterable yearning," to get at the integument of man or some other mammal.

LANDON, who wrote the best book about our adventure into Thibet some ten years ago, entitled *Lhassa* (London 1905) says of Sikkim:

> The game here is very scanty; the reason is not uninteresting. For dormant or active, visible or invisible, the curse of Sikkim waits for its warm-blooded visitor. The leeches of these lovely valleys have been described again and again by travellers. Unfortunately the description, however true in every particular, has as a rule, but wrecked the reputation of the chronicler. Englishmen cannot understand these pests of the mountain-side, which appear in March, and exist, like black threads fringing every leaf, till September kills them in myriad millions. . . . to remove them a bowl of warm milk at the cow's nose, a little slip-knot, and a quick hand are all that is required. Fourteen or fifteen successively have been thus taken from the nostrils of one unfortunate heifer.

When fully fed, a process which takes some time with *Haemadipsa zeylanica*, the individual leeches drop off; and they can be made to loosen their hold by the application of a solution of salt or weak acid. Attempts to pull them off should be avoided, as parts of the biting apparatus are then often left in the wound, and these may cause inflammation and suppuration.

When winter approaches the leeches die down with extraordinary rapidity, and the species "carry on" over the cold weather period in the form of eggs laid in cocoons on the ground, under leaves or other *debris*. Hence no land leech ever sees its offspring, and no land leech has ever known a mother's care.—BRITISH MEDICAL JOURNAL.

THE CAUSE OF BERIBERI.

A recent Bulletin of the National Museum of Science and Art, Dublin, contains some interesting information with reference to that group of compounds which are found in cereal grains in the aleurone layer, viz., the outside layer of the endosperm (sometimes called the food-bag) lying immediately below the seed-coat. This aleurone layer contains no starch in the cells composing it, but is rich in oil and proteid matter, and is well nucleated.

In the grinding of corn by modern machinery this layer goes off with the seed coat as bran, which forms about 15 per cent. of the grain.

The writer of the article in the bulletin (T. Johnson) goes on to give fuller information on this important subject in the summary given below:—

The fate of the aleurone layer in milling has now become increasingly important owing to the discovery that it is the main seat of the recently discovered new group of chemical substances, called Vitamines, by Dr. Casimir Funk, who has been investigating them since 1911. The discovery and isolation of these bodies form an epoch-making advance in bio-chemistry. It would be out of place to discuss here their chemical nature. They are highly complex compounds, present in exceedingly minute quantity. They are nitrogenous, do not contain phosphorus or lime, and are not fatty bodies. One part in 100,000 parts of rice of barn represents the proportion of vitamines present.

Vitamines are indispensable for life and no diet is complete without them. They are necessary for the brain, 'one of the three legs of the tripod of life.' If the brain is starved by a vitamine-less diet troubles of all kinds—deficiency diseases—arise and may end in death. The muscles dwindle away, nerves degenerate, heart and bone troubles occur. In babyhood growth is stopped or at the best is dwarfed.

Vitamines are formed in plants and are found especially in their seeds. So far as is known at present, animals are incapable of making them. By feeding on plants, however, animals obtain them. They thus occur normally in meat, fresh milk and in yolk of egg. They are soluble in water, and are destroyed by heating much above the boiling point of water or by pronounced dryness. Too dry grass and sour grass give vitamineless fodder. In sterilised and condensed milk the heat used destroys them. Lack of vitamines in a baby's food has, as one of its commonest secondary effects, the development of tuberculosis.

Funk regards them as the mother-substance from which the all-important ferments, hormones and other indispensable agents in the life-processes of the body are derived.

In estimating the value of wheat and other grains as articles of food they are of primary importance. The diet standards of the text-books must be revised in the light of their discovery.

White flour and corn-flours generally are deficient foods. When main reliance is placed on them they cease to be the staff of life and become a broken reed. Different grains are eaten in different parts of the world, and wherever any grain is, by machinery, robbed of its aleurone layer and still made to serve as the chief food of the people, there a deficiency disease appears. Rice is eaten by more people than any other grain. Until the primitive stone-grinding of the whole grain had been replaced by modern machinery giving the polished rice, thus robbed of its aleurone layer, the dreadful disease Beriberi was almost unknown. Now it claims thousands of

victims annually in tropical Asia (50,000 in Japan alone), in Africa, in S. America, and is not unknown in Europe. Ireland has several times suffered from outbreaks of it, especially in asylums. Latent beriberi is sometimes revealed by injury or over-exertion. It is due to the use of vitamineless polished rice or occasionally of white wheat flour alone. The United States Government has already made polishing of rice illegal in the Philippines. Another grain- machined Indian corn—is largely eaten in North Italy, the Balkan Provinces, the southern United States, and Brazil. In all these countries the disease called Pellagra which affects the skin, digestive organs, and mental powers, is pronounced. The disease is steadily on the increase in the United States. Every year many thousands of the country people are attacked, of whom 25 to 50 per cent. die. The disease could be stamped out by a good supply of potatoes, one of the most practical and cheapest sources of vitamines.

Mention is made of the fact that the addition of the bean of *Phaseolus max* (Sin. mun) to a diet of white rice has proved a valuable source of vitamines. This fact is worth remembering.

C. D.

THE SUPPLY OF MEDICINAL PLANTS.

The War has even affected the supply of vegetable drugs, the main source of which has been Mid-Europe, particularly Germany and Austria-Hungary. As a result of the altered situation the cultivation and collection of medicinal plants must in future be looked for in England and the British Colonies. At present drug farms are found in England at Mitchan, Carshalton, Hitchin, Ampthill, Long Melford, Steppingly, Market Deeping and Wisbech.

The Board of Agriculture and Fisheries referring to this subject in a leaflet just issued says that though it is easy to overload the market, handsome profits should be made in the near future by those who can successfully raise good crops.

The Board suggests co-operation between growers and wholesale druggists, such as has been resorted to between producer and manufacturer in the case of Cinchona, with a view to restrict the output within reasonable limits.

There is some scope for the tropics to help in the British supply of such plants as Datura (D. Spanicum and D. Tatula), Fennel, Dill, Mullein, Rue, etc.

C. D.

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Guinea fowls **Rs. 48,** Pigeons **Rs. 6,** Partridges **Rs. 6,** per dozen

Quails to order.

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Usual discount to the TRADE.

HENNA.

This favourite ornamental shrub (*Lawsonia alba*) common in tropical gardens is cultivated in Egypt and India for the dye yielded by the leaves. An account of henna cultivation in the Agricultural Journal of Egypt by Mr. W. Cartwright of the Agricultural Department there gives some interesting details. Propagation is generally done by cuttings, though in India it is frequently done by seed. In the first year only one crop is taken, but later two are secured, in September and November, the latter being the better both in quantity and quality. The crop is ripe when the flower buds begin to form or when the upper leaves become dark green.

In harvesting the shoots are cut down to about 4 or 5 inches from the main stem. These are made into small bundles the same day they are cut, and set up on end to dry in the sun, but not long enough for the leaves to lose their green colour. When sufficiently dry the bundles are beaten with sticks. The shed leaves are winnowed to free them from stalk, sand etc. and then ground in a stone mill to powder which is carefully sifted to free it from impurities.

The long stalks left after beating out the leaves are sold for basket-making, which is carried on in most henna-growing villages.

The cultivation of henna is profitable where suitable conditions exist and the cultivator does not stint labour, water or manure in raising the crop. A regular supply of water is the chief desideratum.

The powder is used as an article of toilet, being moistened and used to dye the nails and applied to the palms and soles to soften the skin. Sometimes it is employed for dyeing cloth and leather. The dye is reddish-yellow. The powder is also much used externally mixed with vinegar or water for prickly heat and for strengthening the skin of newly healed wounds.

In Egypt about a third of the crop is used locally, the rest being exported to France, Algeria, Austria, Bulgaria, Russia and Greece.

A scent is distilled from the creamy white flowers, sometimes called "tree-mignonette."

C. D.

THE TRANSMISSION OF SEEDS, CUTTINGS AND PLANTS.

Dr. David Fairchild, Agricultural Explorer to the United States Department of Agricultures, has written a valuable bulletin on this subject from which the following information is extracted :—

The difficulties of sending living plants are generally exaggerated, while the dangers, on the other hand, are almost universally underestimated. Properly selected cuttings or scions of most of the common woody plants, if properly packed and kept at a temperature between 50° and 60° F. (10° and 15° C.), can be shipped halfway around the world. A single cutting infested by a scale insect or a parasitic fungous disease may infect a whole country and lead to the destruction of a great plant industry.

It is with the object of explaining how this introduction of new plant material should be done in order to avoid the dangers of introducing disease and to insure the arrival of the material in a vigorous growing condition that this circular has been prepared.

The easiest and at the same time the safest way to send plant material is in the form of seeds, whenever these will reproduce the same variety as the mother plant from which they came. In general, the cultivated tree fruits and shrubs are the result of grafting, and plants grown from their seeds do not produce the same quality of fruit as the parent. This fact can generally be easily determined, for those who are growing the plants, even though they belong to savage tribes, know how the plants are reproduced. If the plants are wild, it is always safest to send their seeds if they can be secured. If not, the attempt should be made to send cuttings on the chance that they may succeed.

SEEDS.

Seeds should be fully ripe when collected. They should be pure seeds, i.e., not mixed with other seeds. It is, of course, sometimes impracticable to clean seeds in the field, and the correspondent will have to depend upon the seed-clearing apparatus of the Department of Agriculture to remove all weed seeds when the shipments arrive. Seeds should be dry, but not dried in the bright sun-light—rather by being spread out in the shade.

Seeds vary enormously in their vitality. Some seeds die in a few days if dried out, while wheat and other grains retain their vitality for 20 years or even longer—not, as sometimes reported, for centuries. In general, small-sized seeds with hard or dry shells, such as grass seeds and grains, melon seeds, and vegetable seeds, can be successfully shipped dry in sacks or envelopes. Large nuts, particularly chestnuts or acorns, and palm seeds or seeds of fruit trees—in fact, any large tree seeds with oily kernels—should be packed in slightly moistened charcoal, preferably charcoal which has been washed to remove the creosote. Sphagnum moss which is barely moist may also be used for this purpose. For some very short-lived seeds, like mango and mangosteen seeds, a slightly moistened mixture of half charcoal and half chopped sphagnum moss has been very successful.

Seeds taken from fruits should be thoroughly washed and cleaned of fruit pulp and dried in the shade before packing in charcoal, as the chief danger in the shipping of such seeds is from molds which get started in the bits of decaying pulp attached to the seeds and grow into the living seeds themselves.

If all the packing material is first washed in 2 per cent. formalin and then thoroughly washed in boiled water, the chances of molds injuring the seeds seem to be lessened.

Mr. Burkill, Director of the Singapore Botanic Gardens, recommends for mangosteens first washing the seeds with weak carbolic acid, and then packing them in moist charcoal previously sterilised with carbolic acid. Seeds treated this way germinated well after a journey extending over 3 months.

CUTTINGS.

It is not always easy to find out except by experiment whether a small piece of a plant when put in sand or water will form roots and grow or whether it must be grafted on some other rooted plant. If it roots, it is called a cutting: if it has to be grafted by any of the many ways of graftage, it is called a scion. Cuttings and scions should be selected with great care. They should be branches of the plant which have made a vigorous, clean growth. The buds should be well formed. Every cutting should be inspected, to make sure that no scale insects or disease spots are on it, and only those sent that have clean, healthy bark. The diameter of the cutting to select varies greatly, depending upon the species. Large cuttings carry better than small, slender ones. In general (there are many exceptions), a cutting or scion should be taken from that part of the branch which has finished its first season's growth and is not yet 2 years old. After the leaves fall is the best time to take cuttings of deciduous trees and shrubs—hardwood cuttings.

Cuttings of soft-wooded plants, such as geraniums, are somewhat more difficult to send long distances, as they are likely to decay. They often arrive, however, in good condition. These cuttings can be taken at almost any time, but it is important that they have the proper texture or age. If upon being bent the shoot snaps off squarely, so as to hang together with only a bit of bark, it is in the proper condition for cuttings, but if it bends or simply crushes it is either too old or too young. Scions of the orange or plants with evergreen leaves can be taken at any time of year and the leaves cut off.

Many methods, some of them very complicated, of packing scions or cuttings have been experimented with, but packing in damp sphagnum, wrapping in oil paper and inserting in a tin cylinder has yielded as good results as any yet tried, although our agricultural explorers, who send in large quantities of material, often abandon the use of tin tubes and sew up their bundles of scions in strong cotton cloth, after wrapping them in moist sphagnum and oiled paper, thus saving expense in postage.

PACKING IN TINS.

Mix the moss thoroughly with the hands until it is all of the same degree of dampness. Do not add more water or moss. Spread this out carefully at one corner of the waxed paper, lay the cuttings or scions, from three to six, depending upon the size, on the moss, covering them lightly with it. Fold the corner of the paper down and then roll the cuttings and moss in the paper just tightly enough so that the roll will go in the tin, folding the side corners of the paper in under the roll. Write the name of the plant, its variety name, the date, and the locality where collected on a slip of paper and put it in the roll. Put this roll into the tin, place the cap on, and put the tin in its sack.

Paste the necessary postage stamps on the tag which accompanies each tin. Arrange, if possible, to keep the tins cool in transit on board steamer.

ROOTED PLANTS.

While small rooted plants may be shipped short distances in mailing tins if their roots are wrapped in moss and their tops left uncovered, in general rooted plants which will stand an ocean voyage are too large to send by sample post and must be forwarded by parcel post, express, or freight.

To prepare these plants for shipment, they should be carefully dug without injuring the many fine, fibrous roots. A small ball of earth should be left around the roots if the plant is an evergreen one, but from the roots of trees which drop their leaves in autumn (deciduous trees) it is better to shake out the unnecessary soil and pack the roots carefully in moist sphagnum moss, tying this moss securely around them with twine. The tops should not be wrapped, except for frost protection when shipped in freezing weather. Several individual plants, each carefully prepared, can be packed in a well ventilated box, the important point being to fasten each plant securely in the box so that it cannot tumble around in it, no matter on which side the box is laid.

By placing balled plants so that their roots are toward the ends and their tops together in the centre of the box, the foliage of evergreen plants can be given more air and thus be prevented from falling off. By alternating the tops and roots much space can be saved, and this can be safely done with plants which have no leaves on them.

The ventilation of a box of plants is important, and in general several 1-inch holes, bored in the region where the tops of the plants are located, afford sufficient ventilation if they are on all four sides of the box. Every hole in a box of plants should be covered with a piece of wire screen to prevent rats and mice from getting into the box while it is on board ship.

It is of the utmost importance that plant shipments be kept cool in transit, and wherever possible arrangements should be made with the purser of the steamer which carries them to have the box put in what is known as the cool room (not the cold-storage room), where a temperature between 35° and 50° F. is maintained. The optimum temperature is about 50° F.

WARDIAN CASES.

In shipping tender tropical plants long distances it is generally necessary to send them in what is known as a Wardian case, a kind of portable greenhouse. A strong wooden box is made, with an extra strong bottom raised off the ground on short legs and having handles at each end. The sloping roof is composed of two glazed sashes, one of which is hinged at the ridge pole, so it can be raised like a box lid. The glass is protected by strong slates, and ventilation is provided by two small holes, one at each end of the box near the ridge pole. These holes are covered with wire netting. Wardian cases must be carried on the deck of the steamer in order to give the plants light, but they should be placed under an awning and must be protected from salt spray and the salt water used in scrubbing down the deck, which are very injurious to foliage. The plants must be watered about once a week in transit, a thorough soaking with fresh water being sufficient. If packed around with damp coconut fibre, the plants will require less frequent watering.

SMUT IN SORGHUM.

To prevent this common disease which is found in the ears of grain as a black fungus the seed should be treated to kill the spores which propagate the disease. There are three recognised ways of doing this as described by MR. POLE EVANS in the SOUTH AFRICAN AGRICULTURAL JOURNAL.

THE FORMALIN TREATMENT.

In the case of the formalin treatment two methods of procedure are available. Both require 1 lb. of formalin to 30 gallons of water. In one case the seed may be steeped in the solution, while in the other it may simply be sprinkled with it.

If it is decided to steep the seed it should be allowed to soak in the solution for two hours. The seed should be placed in bags and then immersed in the solution. During the time that the bags are soaking they should be lifted up and down at least two or three times so as to remove all air bubbles that may become entangled between the seed.

As soon as the bags have been immersed for two hours they should be taken out and set in such a position that the liquid can readily drain away. The seed should then be spread out to dry on a clean bucksail or other suitable place. As soon as it is dry it may be sown. In handling the grain after treatment it is most important that it does not come into contact with any article that is likely to be contaminated with smut spores, such as sowing machines or old grain bags, otherwise the seed will be infected again

The sprinkling method consists simply in spreading the grain on a clean floor or bucksail and then watering it with the same strength of formalin solution as is mentioned above. The grain should be shovelled over and over until all the seeds are thoroughly wet. As soon as this is done it may then be shovelled up into a heap and covered over with a sail-cloth or some damp sacking to keep in the fumes of the formaldehyde gas. It may be left thus overnight and in the morning spread out to dry.

HOT WATER TREATMENT.

The principle of the hot water treatment lies in the fact that by means of the temperature of the water it is possible to destroy the smut spores adhering to the grain without actually injuring the grain itself. Most of the spores of cereal smuts are ailed immediately if they are exposed to temperatures above 120° F.

In the case of Kaffir corn, if the grain is soaked in hot water at a temperature of 134° F. to 140° F. for ten to thirteen minutes all the smut spores can be effectually destroyed.

The most efficient, and at the same time perhaps the simplest, method of doing this is to obtain two large casks, vats, or other convenient receptacles, and place in both sufficient hot water at 135° F. that will cover well over the bag of grain under treatment. The casks should be arranged side by side in close proximity to one another. The bags of grain to be treated should then be immersed in the first cask, and after lifting it up and down two or three times to get rid of as much air as possible it should be taken out and plunged immediately into the second cask, where it should be completely submerged for ten to fifteen minutes. The object of immersing the bag in the first cask is merely to bring it up to the temperature of the water before immersing it in the second.

As soon as the sacks have been drained after treatment the grain may be spread out in any convenient place and dried, when it will be fit for sowing.

In treating Kaffir corn by this method it is most important to keep the temperature of the water in both casks as near 135° F. as possible. Under no circumstances should the temperature be allowed to fall below 130° F. or rise above 140° F.

COPPER SULPHATE OR BLUESTONE TREATMENT.

The copper sulphate treatment consists in steeping or sprinkling the grain in a solution composed of 1 lb. of copper sulphate to 10 gallons of water.

If it is intended to dip the grain in this solution, only wooden or earthenware casks or receptacles should be used, on account of the corroding action of bluestone. The bags, after they have been lifted up and down to get rid of the air, should not be allowed to stand in the liquid for more than three minutes, when the grain should be immediately taken out and dried.

Instead of steeping the grain the same solution may also be used for sprinkling it, with equally good results. The grain is simply piled up into heaps and the copper sulphate sprinkled over it, while the seed is frequently shovelled over until every grain is thoroughly wetted. As soon as this is accomplished the grain may be spread out to dry.

WATTLE BARK IN EAST AFRICA.

With the growing importance of this industry in the Protectorate, it was felt that the latest information regarding wattle culture and the methods of drying the bark for exportation should be collected, and Mr. Barlow, Plant Inspector, Mombasa, was sent on a mission to Natal for this purpose. During this visit he had an opportunity of inspecting a number of the larger plantations, and the data collected by him should prove of much value to our wattle planters.

It would appear from his report that the conditions obtaining in the Protectorate are, if anything, more favourable for wattle culture than in Natal, and this is supported by the prices realised for consignments of bark which have recently been exported, and further, by the yield (up to six tons) obtained per acre.

It is estimated that some 7,000 to 7,500 acres of land have now been planted out with wattle. The extent of the plantations ready for barking does not exceed 200 to 300 acres, but from two years onwards the annual output of bark should amount to above 7,500 tons.

The rates for railage to Mombasa have been reduced considerably, but the freights are very heavy, and in this respect the Natal planters have an advantage over our planters.

It is hoped, however, that when the output of bark amounts to 7,000 tons per annum factories for the extraction of the tannin will be erected in the Protectorate, and that the tannin extract only need be exported.

Some difficulty will be experienced in the Kikuyu and Limoru Districts in the air drying of the bark owing to the extra humidity of the atmosphere, and experiments are now being conducted on the Kabete Experimental Farm with a view to finding some practical method of drying the bark with artificial heat.

The question also as to the best spacing of the trees has still to be worked out, but the definite data on this point will not be available until our younger plantations (where blocks have been planted out at varying distances) have reached the harvesting stage.—Annual Report of the Dept. of Agric., Br. E. Africa.

SERICULTURE IN S. INDIA.

The report of Signor Mari who was appointed for a year by the Maharaja of Mysore to advise on the improvement of sericulture as carried on in the State, is to hand, and his conclusions after a year's work are to the following effect :—

For sericulture, mulberry cultivation is not all that is wanted; the main point is the rearing of silk-worms, but unfortunately all the conditions fit for growing mulberry are not always sufficient for rearing silk-worms conveniently. Then, if it may be affirmed in a general way that in all parts of the Mysore State mulberry cultivation can be successfully tried, it is not to be believed that also silk-worm rearing will be paying everywhere; and moreover when a silk-worm crop fails, the rearers lose not only the crop of leaves but also the expenses and the labour of rearing.

So that where the conditions are not quite fit, where the temperature is very high and where scarcity of labour is felt, it is better not to substitute sericulture for the products which give already good profits. Therefore in introducing sericulture in new places it is necessary to proceed with the greatest caution, and not to create unreasonable enthusiasm among the raiyats before conducting conclusive experiments; otherwise the raiyats can be bitterly deluded and may lose confidence in all new enterprises proposed to them.

The introduction of the European silk-worm breeds would be advantageous, especially of the Italian breeds, which have always shown a particular adaptability in all parts of India where experiments were conducted with them, particularly in the Government Silk-Farm at Ghannapatna in last March.

Nevertheless it is not to be forgotton that such breeds are habituated to a climate and temperature very much different from that which they find here, and moreover the eggs imported from Europe require special care during the periods of incubation, which with very great difficulty could be offered at present by private rearers.

If in Cashmir it is possible to rear these breeds, it is due to the climate being practically the same as in parts of Europe where sericulture prospers admirably. Unless the rearing rooms and the methods of rearing are perfected, I cannot suggest the abandonment of the local Mysore breeds, which, though habituated from many generations to the climate, frequently suffer greatly.

C. D.

CEYLON AGRICULTURAL SOCIETY.

PROGRESS REPORT LXVI.

MEMBERSHIP.

Since the last meeting held on 24th November, 1914, the following members have joined the Society :—

H. Poyntz-Wright ; The American Consul, Colombo ; George Benzie ; B. Abeysundera ; E. Long; W. L. Mesman ; D. G. Cameron ; W. T. Samaraweera ; M. Towfique ; C. Kumbalatera ; L. B. Bulankulame ; K. S. Pantulu ; E. A. Reid ; Popular "Guaahan" Club ; M. Mooneswamy & Co. ; Rev. J. P. M. Gibson ; J. Cikot ; C. Canagaratnam ; T. W. T. Perett ; F. I. S. Sutherland ; George Farmer ; The Manager, Nan Heng Rubber Estate ; The Mexican Crude Rubber Co. ; V. Palmgren ; Okinawaken-Tokyo-Shikenjo ; E. Salis ; Taiwan-Sotokufu-Shuchikiyo ; M. P. Pitot ; M. A. Subha Rao ; J. E. Edie ; Sam K. Dickson ; M. H. M. Samseedeen

The total membership at date is 1,864.

STAFF.

The Secretary visited the following centres during the period under review :—Gampola, Nawalapitiya, Talawakele, Palugama, Welimada, Badulla, Badugama, Haldummulla, Balangoda, Ratnapura, Ruanwella, Kegalle, Kadugannawa, Galagedera, Weuda, Kurunegala, Wariapola, Nikaweratiya, Hettipola, Boyagane, Teldeniya, Urugala, Nugatenne, Mediwaka, Kegalle, Bandaragama, Weragoda, and Amblantota.

Since the outbreak of the War, the travelling of the Agricultural Instructors has been curtailed with a view to keeping down expenditure, and they have attended only to work at their stations. It is, however, by moving about the country that the Instructors are able to keep in touch with the village cultivator, and it is to be hoped that at no distant time they will be able to resume their usual itineraries.

Mr. K. Chinnaswamy Pillai, late Foreman of the Dry Zone Experiment Station at Anuradhapura, has been seconded for service as Agricultural Instructor, Batticaloa, where a Branch Society is about to be established. His services have been applied for through the Government Agent in order that his South Indian experience may be utilised in developing the district.

Mr. S. Chelliah, the Instructor who has been in charge of the Northern Province, has been appointed Maniagar and President of the Village Tribunals, Delft, and assumed his new duties on the 1st of this month. His appointment is bound to result in agricultural improvement to the division and is, it is hoped, an earnest of similar posts being given to men with a training in and penchant for for agriculture. Mr. S. S. Mappanar, who was acting for Mr. Chinnaswamy Pillai in the Eastern Province, will act for Mr. Chelliah in the Jaffna District.

PADDY.

A quantity of "Upland Rice" was obtained through Mr. T. H. Wood of Bulimba, Brisbane, and given to Messrs. Beddewela and Proctor for trial. The former in acknowledging the seed expressed the opinion that the grain appeared to be remarkably fine and was worth introducing if found to suit local conditions. Further information received is to the effect that the seed has germinated well. Crop results will not be available till May.

This variety should do well for dry-farming trials, since in Australia it has been grown like wheat. The sowing rate is 60 pounds per acre and the seed is either broadcasted or planted 10 inches apart, in drills 30 inches apart.

With only fair cultivation the yield in the coastal lands of Queensland is said to be 30 to 40 and up to 60 bushels per acre. The paddy is a five month variety. The result of the present trials will be watched with interest.

A species of *perennial rice* found in Senegal, which has a spreading habit, is more likely to prove useful as a fodder than as a grain crop. A few seeds were secured with the greatest difficulty but they were found to be bad on arrival, though MR. BEDDEWELA reports having one plant thriving.

The final results of the experiments in *green manuring* paddy with sunn-hemp are not yet available.

Trials in the cultivation of *cooly rice* are being made at three centres, viz, Mahailuppalama, Anuradhapura and Nalanda.

In Upper Dumbara, *Carolina Golden* paddy, which was introduced from America in 1911, is being regularly cultivated. The rice is of excellent quality. At Mediwaka, a nursery of seedlings is about to be transplanted into a field, which, when inspected at the end of February, was carrying a fine crop of sunn-hemp.

MR. W. MOLEGODE, Agricultural Instructor, is this season adopting thin sowing at Uduwawela in Harispattu, using one instead of the usual two bushels per acre ; while MR. NUGAWELA, Agricultural Instructor, is testing the comparative advantages of planting 1, 2, 3, 4 and 5 seedlings 9 inches apart. So far the test is in favour of 3 or 4 seedlings.

THE SOCIETY'S GARDENS.

The following notes will give some idea of the work going on in these gardens :—

Mediwake Garden is now carrying crops of Hickory King Maize, English Potatoes, Cotton and Spelt wheat.

Kegalle Garden has greatly improved in appearance. New and attractive labels have been provided for the trees, showing the popular, botanical and Sinhalese names ; and a summer house in the centre of the garden is in course of construction.

The crops at present growing in the rotation garden at *Hettipola* are cotton, cassava, green gram and sorghum.

The Nikaweratiya Garden is entirely devoted to cotton.

The Bandaragama fruit garden has been extended and manured. A small crop is expected this year.

The Badulla Garden when inspected in December last was bearing a fine crop of English vegetables, besides Sorghum and Soy beans.

The Ambalantota Garden is under cotton, castor and Sudan Dhura.

The Weragoda Garden is mainly devoted to fruits, of which there is a large and varied collection on the land. A fairly large extent is devoted to pine-apples, as at Bandaragama. Propagation by grafting is being carried on here.

The chief aim at the Garden recently started at *Jaffna* is the introduction of crops new to the district.

COTTON.

In September 1913, 7 lb. of a new variety of cotton was received from the British Cotton Growing Association. In forwarding it the Manager referred to the cotton as the result of a hybrid obtained from Sea Island by MR. THOMAS THORNTON, at one time an expert of the Imperial Department of Agriculture in the West Indies, who had given special attention to its production.

This seed was planted rather late in the season in the Society's Garden at Ambalantota (S. P.), Hettipola and Nikaweratiya (N. W. P.), but at the time of the cotton harvest the new variety gave a very poor yield, and the plants appeared to be making too much wood. In view of this experience it was decided to allow the crop to stand for another season, and on a recent inspection of the two N. W. P. Gardens the bushes were found to be in excellent condition and bolling heavily. What is extraordinary about this cotton is that it has weathered seasons of rain and drought and appears none the worse for the experience. The present season's crop will be sent to the British Cotton Growing Association, from whom in the meantime further particulars have been solicited as to the exact origin of the variety.

Cambodia cotton is being grown in Hambantota District, as well as at Dambulla, Sigiriya, Naula and Mediwake. Allen's long staple is being cultivated in Wannihatpattu. The cotton crop will have been taken in by April next.

SEED AND PLANT SUPPLY.

The temporary extension of the privileges of the Society to the General Public between October and December last, by the offer to supply seed in order to facilitate the cultivation of quick-growing vegetables so as to meet any possible shortage in the food-supply from what cause soever, has created the erroneous impression that the public can always draw upon the Society's stocks of seeds and plants. It is as well, therefore, to make it quite clear that *only members* of the Society are entitled to the privileges it has to offer. If it were otherwise there would be no incentive to join the Society, which indeed would not justify its existence.

In return for their subscriptions members are entitled to receive (1) free copies of the Society's periodicals and leaflets in English, Sinhalese and Tamil, (2) information and advice about agricultural matters, (3) a supply of seeds and plants at actual cost price.

There are, of course, a large number of members to whom the Tropical Agriculturist is the chief attraction, but there are also members who seldom if ever read that periodical, while to others the vernacular publications are of greater importance.

To a great many local residents the "connection" which their membership creates is the greatest privilege, since it provides them with an agency free from official formalities, always ready to assist them, and through which they could obtain any information they needed.

That the functions of the Society as an intelligence bureau are appreciated is proved by the extensive correspondence it has to deal with.

Lastly, as a medium through which seeds and plants could be obtained at the cheapest rates, the Society serves a practical purpose. It is only when one is in need of particular varieties of plants and seeds that he realises the difficulty of procuring them. The status of the Society and the large orders it can place at one time, make it possible for it to act as a Co-operative institution and secure advantages for its members which they could not gain as individuals.

It is not to be expected, therefore, that any of these privileges to its members should be enjoyed by non-members. Such procedure would be unfair not only to the members but also to dealers in plants and seeds.

The simple and proper course for those who would participate in the advantages which the Society has to offer is to join it as members and pay the small annual subscription of Rs. 10, which includes a free copy of the Tropical Agriculturist and other publications.

MISCELLANEOUS.

The results of growing Teff at the Experiment Station, Peradeniya, were highly satisfactory. It took 6 weeks to mature and yielded a crop equal to 5 tons 2 cwt. per acre of green fodder or 1 ton 9 cwt. of dry.

At Badulla Garden the yield of dry fodder was equal to 1 ton 2½ cwt. per acre.

At the suggestion of a correspondent the following notes on the curing of chillies, turmeric and ginger are given for the benefit of members interested:—

Chillies.—The capsules are dried in the sun on rocks (where available) or mats, the operation taking about a fortnight, and then, when thoroughly dry, are tightly packed and sewn up in coarse bags.

Turmeric.—After dividing up any particularly large rhizomes the turmeric is dried and then boiled. In India it is a common custom to add some cowdung to the water in which the turmeric is boiled, but whether this is necessary is doubtful: it is certainly not a nice idea. As soon as the water begins to boil the ginger is taken out and again spread out to dry. The rhizomes should be handled (rubbed) and turned over at intervals. Drying takes about a week.

Ginger.—After digging out the ginger is dried in the sun and the adhering earth removed as far as possible. It is then soaked to soften the rhizomes and facilitate the removal of the outer skin which is done by means of a piece of shell or earthernware. After this rubbing by hand, soaking and drying is done as often as necessary till the rhizomes are thoroughly bleached and dried.

Seeds of three varieties of the African oil palm (Abepa, Abedom, Abebobe) were procured from the Gold Coast for a member resident in Matale North where specimens of the palm are to be found growing and bearing well. The Director of Agriculture, Gold Coast Colony, advises that the seeds should be placed 2 inches apart in the nursery and the beds well watered till they germinate. The seedlings are planted out when about one foot high and put at distances of 30 feet apart. The seeds usually take many months to germinate. A work dealing with the cultivation of "The Oil Palm" by F. M. MILLIGAN has recently been published.

Reference was made in the TROPICAL AGRICULTURIST for September last to the McChesney Copra Drier, and at the request of members interested further enquiries were made from the Bureau of Agriculture, Philippines, and there is now a prospect of a local agency taking up the sale of the machine.

There are not less than 25 acres of the Cluster Sweet Potato under cultivation in Dumbara this season. This variety, introduced by the Society from Australia some years ago, is being cultivated in all parts of the Island and is being selected for its hardy qualities and prolific character.

The new edition of the Societys' year book was issued at the end of last year and by now must be in every member's hand.

The Secretary has received complimentary letters, which go to indicate that the book is appreciated.

It is the hope of the compilers to fulfil the expectations of the Director of Agriculture and next year make it what it should be, viz., "a note book of Agriculture."

The Society has lost through the death of MR. ANDREW RUTHERFORD, late Government Entomologist, an enthusiastic worker whose advice was readily available on all questions referred to him on behalf of members, and would record its appreciation of the services of the deceased officer while offering its respectful sympathy with MRS. RUTHERFORD.

Peradeniya,
23rd February, 1915.

C. DRIEBERG,
Secretary, C. A. S.

SOME PRIMITIVE PROCESSES OF AGRICULTURAL PRACTICE AND THEIR SIGNIFICANCE.

(Paper read at the Meeting of the Ceylon Agricultural Society, February 22nd, 1915.)

The investigation of processes of cultivation in use in a country from its early times is of great value in formulating any scheme for the improvement of its rural industries.

Agriculture is the main rural industry of Ceylon. The production of grain, fruit and vegetables for the immediate requirements of the people and the breeding of cattle for draught and dairy purposes has been carried on systematically in the Island from remote times.

Modern conditions of land tenure and regulations for the conservation of forests and irrigation works, the increase of population in certain areas and depopulation of other Districts have altered modern conditions of rural agriculture. The Ceylon cultivator had not been sufficiently educated to gradually adapt himself to the new conditions as they arose.

Those who should have guided the cultivator, it is evident, had not sufficiently grasped the conditions prevailing in the country. Western conditions were foremost in their minds. The burning of forest or jungle after it was cleared or the burning of the soil before its cultivation was condemned in severe terms as wasteful practices. The cultivation of rice on dry land was considered to be wasteful and uneconomical. The large quantity of grain sown on the soil was condemned as a waste. The ploughing of land with the cultivator was considered to be almost a useless practice. In wet cultivation it was supposed that water was unnecessarily wasted and that puddling was unscientific. The method of breeding draught cattle was considered to be primitive.

However a notable change in these ideas was brought about some years since Prof. Robert Wallace, a practical agriculturist, visited the Tropics and published a work on the Agriculture of the East which struck a new note. He declared that the work of the cultivator in the East had a good deal to commend it and some of the new methods were utterly unsuited to his requirements ; and improvement should be sought by helping the cultivator to perfect his old methods in consonance with modern conditions. After the appearance of Prof. Wallace's book Dr. Voelcker was engaged by the Indian Government to make a comprehensive report on the subject. Dr. Voelcker supported Prof. Wallace in general and prepared a carefully drawn up report indicating the lines for future procedure.

In Ceylon the cultivation of grain has from remote times occupied the attention of the cultivator. Rice was cultivated both on dry and wet land. On dry land the forest was felled and burnt and the seed sown broadcast. A very large extent of land must have been cultivated in this manner, for the old Sinhalese books mention hill rice as the principal article of diet and a grain much superior to what was obtained under wet cultivation. Dry land was always cultivated in rotation and whether the land was held in common or by individuals, only about a seventh part of its extent was cultivated at one time. A rotation of crops was also carried out. A land was first placed under a rice crop followed by a root crop and a mixed crop of cereal, oil seed and cotton and then it was left in fallow. This appears to have been a very good system and in keeping with the latest experience as far as successful cultivation is concerned. The burning of the soil is now admitted to be a very desirable process ; the theory of waste of organic matter and the loss of valuable fertilizing ingredients as the supposed results of burning is no longer held and the ancient system is well justified in modern experience. The restriction and discouragement of dry cultivation in Ceylon

resulted in the disorganization of these old well-ordered methods, for a cultivator when he got the opportunity of clearing a land either with a permit obtained under many disadvantages or surreptitiously without any permit at all could not think of using the land for more than once. A villager or a village community should be given a free hand to divide up a plot of land into different lots, and to take each portion in cultivation each year by turn. Where means of transport are so difficult, labour is scarce and when fertilizers are not available or their application not understood, the seven year system of cultivation is the most rational and the most economical one. In regard to draught milch cattle the old established method enabled a village community to graze their animals on fallow land of the dry plots and on the common grazing grounds of the villages. With the disappearance of this the breeding of cattle has become an extremely difficult matter. Cattle disease that existed as occasional epizootics has now become almost sporadic, for when there is no choice of grazing land, the animals are continually kept on land that has become more or less infected. Under the seven years system the cattle were never on the same land for any lengthy period, and it is well known that after a period of years the infection of cattle plague on a land is almost non-existent.

Wet cultivation was not indigenous to Ceylon to any great extent till the great irrigation schemes came into operation. In Ceylon we are without very large rivers whose water can be utilized for irrigation purposes. The Sinhalese Kings on their own account and at great cost founded a system of artificial irrigation. Under the original system of artificial irrigation almost every drop of rain falling in the country was utilized in a remarkable manner for the irrigation of rice land. The great tanks were reservoirs to supply the deficiencies of village tanks. Every village in the level country had its own village tank which was capable of supplying water for the cultivation of an average of from five to ten acres of ground. The tanks being small, their construction and upkeep did not demand very much labour. The large reservoirs were used to supply these tanks when the rain failed and when there was a scarcity in the water available, thus insuring a regular supply of water to immense tracts of lands. When some of the large irrigation Schemes were restored this original system was evidently lost sight of and even at enormous cost they were not able to bring under cultivation even a tenth of the land they should have done under the old system. In wet cultivation of rice no compromise is possible; for the crop to be a success requires all the water the cultivator seeks. There is a theory which is occasionally put forward that the Ceylon cultivator wastes much water and ought to be compelled to use less water. This is only a theory which when brought into practical use makes the unfortunate cultivator the sufferer. An area of ground which ought to give him forty bushels of paddy under proper irrigation would bring him about fifteen bushels under a scanty supply of water. All the time and labour required for both these results is the same. He gives the labour to the value of about 12 bushels of paddy and gets a surplus of 3 bushels with a stinted supply of water instead of, perhaps, 18 with a full supply of water.

The use of the Ceylon plough and the method of wet puddling were condemned at one time as wasteful practices of a most primitive nature, but recent experiments on the most approved scientific lines have proved that wet puddling gives the best results in rice growing and is justified on the highest scientific grounds. The bacterial theory of soil fertilization, though perhaps not clearly known to the village cultivator, was recognised by him in practice thousands of years before it was discovered by modern scientists.

There are many other minor practices in cultivation usually put down as superstitious which have a scientific basis of great value. I should not go into details regarding these but would mention the finding of hours for sowing, reaping and other operations, the method of protection employed in preventing

people from crossing the fields or entering thrashing floors and the elaborate ceremonies connected with the preparation of thrashing floors, etc. These are means that ensure the proper and suitable seasons for the sprouting and ripening of the crop and to prevent the infection of crops and seeds by plant diseases.

There are many practical lessons that we may draw from the consideration of these and other circumstances for the promotion of the welfare of the cultivator, for extending the cultivated areas in the Island, and for increasing our food supply.

The cultivator should be encouraged to follow his time-honoured methods and to effect any improvements on the foundation thus laid. There is, it is said, much land lying idle in the country waiting the advent of the pioneer. But a few preliminary steps are essential if land is to be reclaimed.

In the first place, with each area of irrigable land there should be available an extent of dry land as its adjunct, land where dry crops can be grown and land which can be used for grazing agricultural cattle.

Any land at the disposal of Government should be available without undue delay, not as a concession but on ordinary business terms. If one desires to acquire a land, and has the capital to invest in purchasing and cultivating it, he should be able to have it immediately he is prepared to pay the money.

No Sinhalese cultivator will willingly be a tenant without land of his own.

The landlord system and the tenant system have to go hand in hand. There are thousands of families in the more congested districts of the Island that would willingly emigrate to other districts if they were able to secure small holdings of both wet and dry land and if they were assured of complete freedom of action in their own holdings, without undue interference by a number of different authorities and if they find that they can have the protection and patronage of large landholders on whose estates they can obtain land on tenant's terms. If, for example, a thousand acres of irrigable land and three or four thousand acres of dry land is placed on the market, half the extent should go to the small holders in blocks of about five acres with a proportionate extent of dry land, and the other half to large holders in blocks of hundred acres of irrigable land and a corresponding proportion of dry land attached.

Were this method of disposal to be followed, all available land under the irrigation schemes are likely to be taken up within a very short period and opened up successfully to the great advantage of the country.

W. A. De SILVA.

Colombo, 10th February, 1915.

SUGAR-CANE EXPERIMENTS.

Recent experiments conducted in various parts of Hawaii have shown that plant cane from an unmanured field will yield from 25 to 30 tons of cane per acre, whilst by judicious manuring these figures reach as high as 40 to 42 tons per acre, and 5 to 6½ tons of sugar per acre were obtained from the completely manured plots against 3 to 4½ tons where unmanured.

As will be seen from the annexed table, which represents results from various experiments carried out in Tucuman, Argentina, the average yield of

cane from an unmanured field was only 18½ tons per acre, which yielded 2 tons 9 cwt. sugar, whilst the completely manured field yielded 22 tons 4 cwt. cane, giving 2 tons 18 cwt. sugar The average profit by the use of manures in this case (based, be it remembered, on the prices ruling before the war) amounted to about £5 17s. per acre, not a large sum by any means but sufficient to show what good cultivation and manuring can do for the planter, and it is to the interest of every planter in the Argentine to follow the lead set by the Hawaiian planters and do for themselves what others have done for the estates in the American colony.

Regarding the question of which fertilizers should be used, it is a well-known fact that nitrogen and potash should be the dominant constituents of a mixture for sugar-cane, whilst phosphoric acid takes a secondary, but none the less essential, place. It would be invidious to suggest any mixture in this article because the soil and the climatic and other conditions must be taken into account.

No. of plot	Manuring per acre	Yield of cane per acre	Percentage of saccharose in cane	Sugar per acre	Increase due to manuring
1	First application: Sulphate of potash 2 cwt.; Basic slag - - 3½ „ Second application: Superphosphate - 1½ „; Sulphate of ammonia 1½ „	21 tons 18 cwt.	12·62	2 tons 15 cwt.	9 cwt.
2	— Unmanured - -	18 tons 5 cwt.	12·41	2 tons 6 cwt.	
1	First application: Sulphate of potash 2 cwt.; Basic slag - - 3½ „ Second application: Superphosphate - 1¼ „; Sulphate of ammonia 1½ „	21 tons 13 cwt.	—	2 tons 14 cwt.	7 cwt.
2	— Unmanured - -	18 tons 13 cwt.		2 tons 7 cwt.	
1	First application: Sulphate of potash 2 cwt.; Basic slag - - 3½ „ Second application: Superphosphate - 1¼ „; Sulphate of ammonia 2 „	22 tons 0 cwt.	12·0	2 tons 13 cwt.	10 cwt.
2	— Unmanured - -	17 tons 4 cwt.	12·5	2 tons 3 cwt.	
1	First application: Sulphate of potash 2 cwt.; Basic slag - - 3½ „ Second application: Superphosphate - 1¼ „; Sulphate of ammonia 2 „	23 tons 6 cwt.	15·55	3 tons 12 cwt.	12 cwt.
2	— Unmanured - -	19 tons 17 cwt.	15·18	3 tons 0 cwt.	—

—TROPICAL LIFE.

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[*Photo by H. F. Macmillan.*]

Papaw fruit on the tree and in section; the flowers are seen at the apex in the axils of the leaves.

[*Photo by H. F. Macmillan.*]

Collecting the milky juice by scarification.

(*See page 179*)